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**2014** Hirsch Research Paper Competition

# It's a New World Out There: The Next 10 Years!

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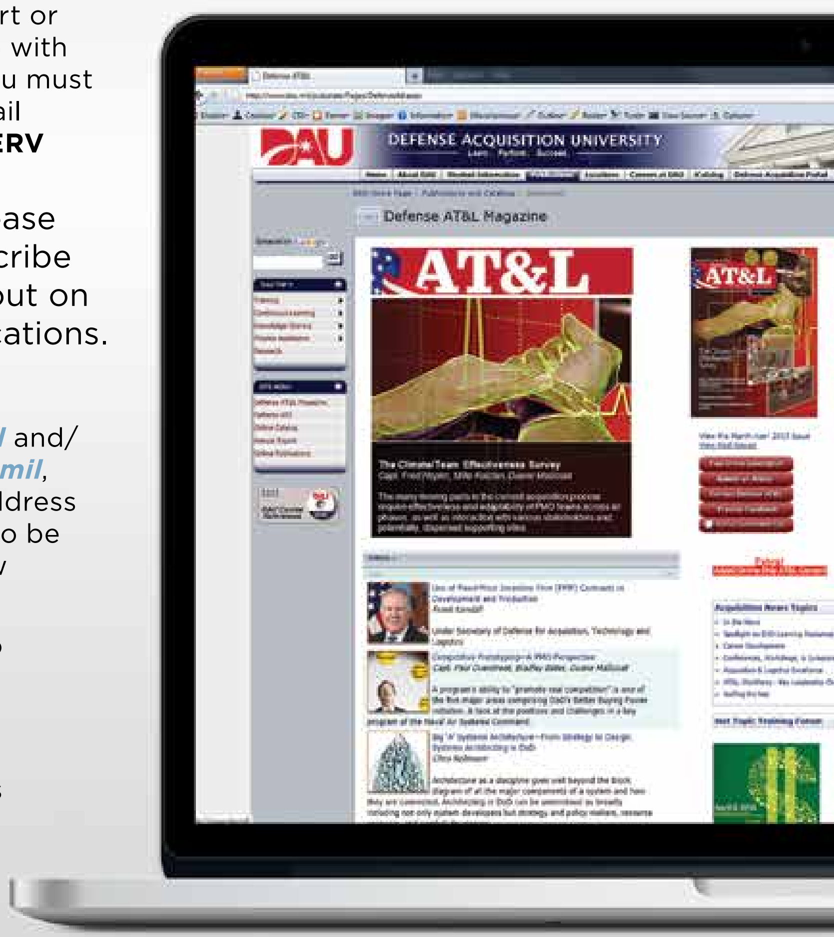

# From the Chairman and Executive Editor

This issue is devoted to the Annual Hirsch Research Paper Competition, sponsored by our partner organization, the Defense Acquisition University Alumni Association (DAUAA) at http://www.dauaa.org. For 2014, the competition was titled, "It's a New World Out There: The Next 10 Years!"

The winning paper for the DAUAA 2014 award, "Path from Urgent Operational Need to Program of Record," by Eileen P. Whaley and Dana Stewart, was selected from a strong field of candidates. The paper describes the current policies, procedures, processes, and required actions to bring a program from fulfilling an urgent need to becoming a full-fledged Program of Record, with an emphasis on the Capabilities Development for Rapid Transition. We also thank all the other authors who participated in the DAUAA Research Paper Competition.

The other papers in this issue are: "Data Rights for Science and Technology Projects" by Larry Muzzelo and Craig M. Arndt, which examines the effects of data rights on the success of transitioning technology from science and technology to Programs of Record ; "Adverse Impacts of Furlough Programs on Employee Work Rate and Organizational Productivity" by Adedeji Badiru, which examines how defense employee furloughs affect fundamental aspects of defense acquisition; and "Applications of Should Cost to Achieve Cost Reductions" by David M. Husband, which describes several approaches used by defense acquisition programs to realize Should Cost savings.

Rounding out this issue is Glen Asner's review of *Engineers of Victory: The Problem Solvers Who Turned the Tide in the Second World War*, by Paul Kennedy.

I note here that the authors' guidelines have been revised to reflect a greater emphasis on the nature and quality of original research, as part of our continuing effort to increase the value of this journal to the Defense Acquisition Workforce.

Dr. Larrie D. Ferreiro
Executive Editor
*Defense ARJ*

# DAU Center for Defense Acquisition Research

## Research Agenda 2014

**The Defense Acquisition Research Agenda is intended to make researchers aware of the topics that are, or should be, of particular concern to the broader defense acquisition community throughout the government, academic, and industrial sectors. The purpose of conducting research in these areas is to provide solid, empirically based findings to create a broad body of knowledge that can inform the development of policies, procedures, and processes in defense acquisition, and to help shape the thought leadership for the acquisition community.**

**Each issue of the Defense ARJ will include a different selection of research topics from the overall agenda, which is at: http://www.dau.mil/research/Pages/researchareas.aspx**

### Affordability and cost growth

- Define or bound "affordability" in the defense portfolio. What is it? How will we know if something is affordable or unaffordable?
- What means are there (or can be developed) to measure, manage, and control "affordability" at the program office level? At the industry level? How do we determine their effectiveness?
- What means are there (or can be developed) to measure, manage, and control "Should Cost" estimates at the Service, Component, program executive, program office, and industry levels? How do we determine their effectiveness?
- What means are there (or can be developed) to evaluate and compare incentives for achieving "Should Cost" at the Service, Component, program executive, program office, and industry levels?

- Recent acquisition studies have noted the vast number of programs and projects that do not make it successfully through the acquisition system and are subsequently cancelled. What would systematic root cause analyses reveal about the underlying reasons, whether and how these cancellations are detrimental, and what acquisition leaders might do to rectify problems?

- Do Joint programs—at the inter-Service and international levels—result in cost growth or cost savings compared with single-Service (or single-nation) acquisition? What are the specific mechanisms for cost savings or growth at each stage of acquisition? Do the data support "jointness" across the board, or only at specific stages of a program, e.g., only at research and development or only with specific aspects, e.g., critical systems or logistics?

- Can we compare systems with significantly increased capability developed in the commercial market to DoD-developed systems of similar characteristics?

- Is there a misalignment between industry and the government priorities that causes the cost of such systems to grow significantly faster than inflation?

- If so, can we identify why this misalignment arises? What relationship (if any) does it have to industry's required focus on shareholder value and/or profit, versus the government's charter to deliver specific capabilities for the least total ownership costs?

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**Keywords:** *Capabilities Development for Rapid Transition (CDRT), Joint Urgent Operational Needs (JUONS), Lethal Miniature Aerial Munition System (LMAMS), Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), Program of Record (POR), Rapid Equipping Force (REF)*

# *Path from Urgent Operational Need to Program of Record*

*Eileen P. Whaley and Dana Stewart*

The United States went to war in the Middle East with a warfighter partially equipped to defeat the ever-evolving threats the enemy brought into the operational theater. In response, units were equipped with urgent, unique solutions that countered the threat. The vulnerability of units in urban hostile situations is one example that led to the development of the Lethal Miniature Aerial Munition System to improve survivability for the troops. The solutions became enduring capabilities, leading the way and bringing a program from fulfilling an urgent need to a Program of Record, with emphasis on the Capabilities Development for Rapid Transition. This article addresses current policies, procedures, processes, and required actions associated with that effort.

*« Image designed by Diane Fleischer*

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"Our front-line forces must be supported by a modern system that quickly meets their needs, not a slow and lumbering bureaucracy better suited to the last century. As important, our military men and women and their families deserve to know that we are giving them the best possible equipment when they need it."

(Biden, Bond, Rockefeller, & Kennedy, 2008)

## Identifying the Problem

In 2002, the U.S. Army was fully engaged on the battlefield in Afghanistan with a combat operation called Operation Enduring Freedom (OEF). During the course of OEF, soldiers and commanders identified urgent needs requiring immediate solutions. The existing Army acquisition process, with complex documentation requirements and extended life cycles for materiel development, made it difficult to satisfy these identified urgent equipping needs in a timely manner.

In 2003, the United States entered into Iraq, in another combat operation called Operation Iraqi Freedom (OIF) where the soldiers and field commanders continued to identify specific capability requirements to meet the emergent threat. Out of those identified capability gaps from OEF and OIF, it became clear that a way to create a process where capabilities could be developed faster was needed. According to Office of the Director of the Army Staff (2011) Army Posture Statement, many of the materiel solutions identified and provided to the warfighters to satisfy urgent needs worked well in theater. Identifying those capabilities worthy of retaining and integrating into the force resulted in the Army instituting a new process called the Capabilities Development for Rapid Transition (CDRT). The CDRT process (Accelerated Capabilities Division [ACD], 2012) is intended to examine and identify the best nonstandard materiel solutions brought into the field to satisfy an urgent need, and determine if the equipment should be retained, sustained, or terminated (Department of the Army [DA], 2011). To be able to provide long-term funding and oversight, retained and sustained equipment needs to be identified as a Program of Record (POR). Therefore, while it was acceptable to acquire the equipment outside of the formal acquisition process, the formal structure assigned to a POR is more recognizable and desirable for maintaining and sustaining the equipment. Some urgent needs or rapid acquisition programs will not go through the CDRT, but will become PORs. During the course of research, it was discovered that existing formal policy, procedures, or regulations lacked sufficient information on defining how the equipment becomes a POR. The process is occurring; however, the documentation is lacking on how the Army incorporates a materiel solution developed for a specific combat mission into the routine training and doctrine to become a POR.

## The Urgent Needs Process

During the course of operations in OEF, OIF, and encounters with the enemy, a need continually existed to rapidly identify and field new capabilities quickly to avoid the failure of the operational mission or catastrophic events. Established during the 1980s, the role of the Operational Needs Statement (ONS) process expanded because of the OEF and OIF operations and the 1990s' Gulf War conflict. According to a U.S. Government Accountability Office (GAO, 2010) report, the Army receives over 300 ONS requests per month. The ONS process is comprised of three elements: requirements determination, resourcing, and development of materiel solutions (including operations and maintenance). The ONS requests range from a need for new capabilities to training equipment for mobilizing units (GAO, 2010).

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According to Army Regulation (AR) 71-9, fulfillment of an ONS passes through several phases: initiation, theater endorsement, command validation, headquarters approval, funding, contract award, and initial fielding (DA, 2009). At first, assessment of the need occurs to determine if fulfillment can occur at the field commander's level. If the need is greater than what the local resources can accommodate, and if it is strictly an Army requirement, it processes through the Army chain of command. The combatant commander prioritizes the need based on whether it will jeopardize soldiers' lives or mission accomplishment if not fulfilled. It is important to note that the ONS is not a Joint Capabilities Integration and Development System (JCIDS) document, and it is not intended for redistribution of equipment already fielded. It is an opportunity for needs validation and sourcing of an identified capability gap (DA, 2009).

As identified by GAO in its 2011 report, one option is a "10-line capability gap" statement sent directly to the U.S. Army Rapid Equipping Force (REF) to start the process, followed by an ONS. The 10 lines included on the "REF 10-Liner" are as follows (GAO, 2011):

1. Problem
2. Justification
3. System characteristics
4. Operational concept
5. Organizational concept
6. Procurement objective
7. Support requirements
8. Availability
9. Recommendation
10. Coordination and accomplishment

The GAO (2011) report identified six activities that are involved in meeting urgent needs: validation, facilitation, sourcing, execution, tracking, and transition/termination/transfer. Interestingly, AR 71-9 does not identify the last category for the actual disposition of the system of equipment once developed. Extracted from the GAO report, Table 1 identifies the key activities and defines the resulting actions.

**TABLE 1: ACTIVITIES INVOLVED IN MEETING URGENT NEEDS (GAO, 2011)**

| Key Activity | Definition |
|---|---|
| Validation | An urgent need request is received from theater and reviewed for validation by a headquarters entity. Validation involves an "in-house" review of an urgent need request to determine if it meets criteria to be recognized as an urgent operational need and, thus, whether it should continue through the process. |
| Facilitation | The requirements, costs, potential solution, funding, and other factors related to the course of action for the fulfillment of the urgent need are developed and coordinated between various entities. This can include, but is not limited to, coordination between validation and solution-development entities, coordination of requirements, and knowledge sharing. |
| Sourcing | Approval of the proposed course of action and assignment of a sponsor who will carry out a course of action/potential solution. |
| Execution | The approved solution is developed and fielded. This includes the acquisition, testing, and other activities involved in solution development. |
| Tracking | Collection of feedback from the warfighter regarding whether the solution met the urgent need request; also collection of performance data regarding course of action and solution. |
| Transition, Transfer, or Terminate | The decision regarding the final disposition of the capability in terms of whether it will be (a) transitioned to a program of record if it addresses an enduring capability need; (b) transferred to an interim sponsor for temporary funding if it addresses a temporary capability that is not enduring, but needs to be maintained for some period; or (c) terminated if it addresses a niche capability that is not enduring, nor is it to be maintained for current operations. |

*Note.* Adapted from "Warfighter Support: DoD's Urgent Needs Processes Need a More Comprehensive Approach and Evaluation for Potential Consolidation," by Government Accountability Office, Report No. GAO-11-273, Washington DC, 2011.

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**TABLE 2. ROLES OF U.S. ARMY ENTITIES IN URGENT NEEDS**

| Service/ Joint | Entity Involved in Urgent Needs | Validation | Facilitation | Sourcing | Execution | Tracking | Transition, Transfer, or Terminate |
|---|---|---|---|---|---|---|---|
| Army | Deputy Chief of Staff, Army G-3/5/7, Current and Future Warfighting Capabilities Division | ✔ | ✔ | ✔ | | ✔ | ✔ |
| | Biometrics Identity Management Agency | | ✔ | ✔ | | ✔ | |
| | Asymmetric Warfare Group | | ✔ | | | | |
| | Rapid Fielding Initiative | | | | ✔ | | |
| | Rapid Equipping Force | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Army Capabilities Integration Center, U.S. Army Training & Doctrine Command | | | | | ✔ | ✔ |
| | PM or PEO | | | | ✔ | ✔ | |

*Note.* Adapted from "Warfighter Support: DoD's Urgent Needs Processes Need a More Comprehensive Approach and Evaluation for Potential Consolidation," by Government Accountability Office, Report No. GAO-11-273, Washington DC, 2011.

The fulfillment of an urgent need that the U.S. Army seeks to resolve involves seven different U.S. Army entities. Table 2 identifies the organizations and indicates what roles (activities) these organizations play in the resolution of urgent needs/ONS. Joint organizations and other military services, however, are not included in this table.

As reflected in Table 2, multiple organizations process and validate urgent needs. For the U.S. Army, an urgent need can be submitted via two routes: a request can be submitted to the REF for approval by the director of the REF (the REF 10-Liner); or a request can be submitted via the ONS (GAO, 2011). Important to note is that validation of an Army ONS is by the Deputy Chief of Staff (DCS), G3/5/7, with resourcing by the DCS, G-4; Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA/ALT); Army Materiel Command (AMC); or the REF that provides the resourcing solution with sustaining and follow-on procurement guidance (DA, 2009).

Solutions normally take 3 to 6 months with a Commercial-Off-The-Shelf (COTS) solution or 12 to 18 months if such solutions require new technologies. A normal acquisition may not deliver a capability for 3 to 5 years (Defense Science Board Task Force [DSBTF], 2009). According to the DSBTF report, the unit submitting the ONS often includes a materiel solution, along with the mission need and identification of the capability gap. The ONS is sometimes satisfied with a COTS solution, possibly modified to meet the intended need. Further, this DSBTF (2009) reported:

> [An] increasing need for formal or informal transition paths from rapid solution to enduring acquisition. One effort in this area is the Army's Capabilities Development for Rapid Transition (CDRT) effort. CDRT identifies new technologies and capabilities in use in theater, evaluates their applicability to the Army at large, and makes recommendations for transitioning these technologies for Army-wide application and sustainment. (p. 9)

## JCIDS and the ONS Process

According to the Chairman Joint Chiefs of Staff Instruction (CJCSI).01H, materiel solutions that are validated do not require a Capabilities Development Document (CDD) or Capabilities Production Document (CPD) during the rapid acquisition process unless they have been designated as a Major Defense Acquisition Program, a Major Automated Information System, or are designated Acquisition Category

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(ACAT) ID (Chairman, Joint Chiefs of Staff [CJCS], 2012). In this case, the Defense Acquisition Executive requires preparation of a CDD or CPD The CDD and CPD may be required to support transition of an urgent requirement to an Acquisition Program Candidate (APC). Within 90 days of rapid equipping to the field, a sponsor such as REF will provide an assessment of whether the solution was a failure or limited success, or success of a limited-duration requirement or success of an enduring requirement.

The Service Functional Capabilities Board (FCB) will establish joint priorities for every ONS. The FCB is "a permanently established body that is responsible for the organization, analysis, and prioritization of joint warfighter capabilities within an assigned functional area" (ACAT, 2013). Eight FCBs establish joint priorities:

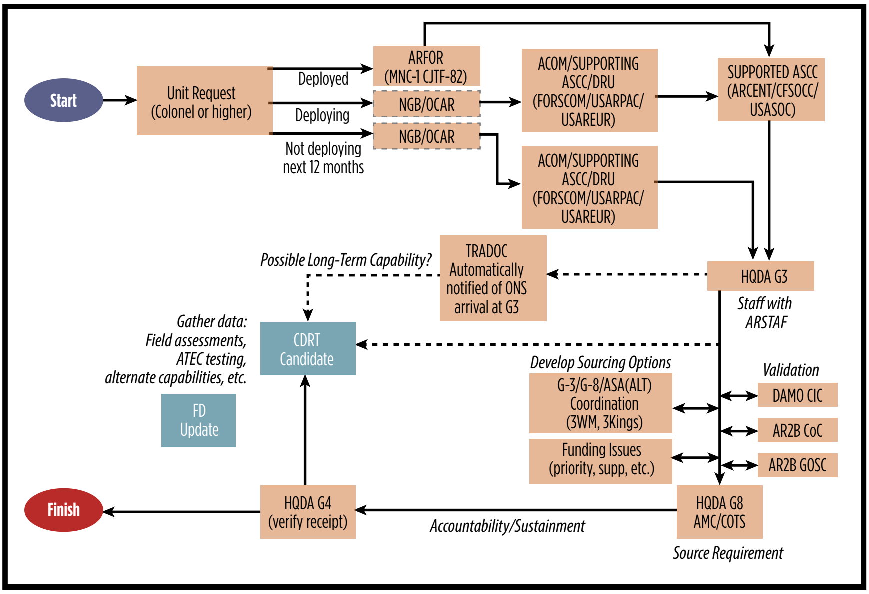
1. Command and Control–Joint Forces Command with J6
2. Battlespace Awareness
3. Net Centric Operations
4. Force Application
5. Focused Logistics
6. Protection
7. Force Management
8. Joint Training

Joint requirements must satisfy Title 10, USC, section 181 statutory requirements according to CJCSI 3170.01H (CJCS, 2012). Figure 1 reflects the process for the evolution of an ONS from initiation to satisfaction.

## Organizations Involved in Resolution of Urgent Needs

The organizations examined in this article that support, develop, and equip the force as a result of capability gaps are the Joint Improvised Explosive Device Defeat Organization (JIEDDO), Asymmetric Warfare Group (AWG), REF, and the Army Capabilities Integration Center. These organizations support and respond to the urgent needs of the Army warfighter.

**FIGURE 1: U.S. ARMY PROCESS TO REVIEW, VALIDATE, AND ASSIGN RESOURCES TO AN ONS**




*Note.* Adapted from "Fulfillment of Urgent Operational Needs," by the Defense Science Board Task Force, Washington, DC, 2009.

Interestingly, the DSBTF found that within the DoD, numerous organizations were involved in developing solutions to urgent requirements. The task force found "more than 20 ad hoc, independent, quasi-institutionalized organizations addressing warfighter urgent needs" (DSBTF, 2009). All are attempting to develop rapid capability.

Our soldiers performing missions in Afghanistan and Iraq began to face a new threat—Improvised Explosive Devices (IED). Increasingly employed by insurgents, IEDs became a strategic element of insurgent operations. As casualties mounted, a number of joint task forces were formed, which culminated in the formation of the JIEDDO in February 2006 (DoD, 2006).

Formation of the JIEDDO created a joint organization whose primary mission was to reduce, eliminate, and defeat IEDs that insurgents were using against U.S. and coalition forces. Further, the organization was to train the joint forces in techniques to mitigate the effects and reduce insurgent IED activities through surveillance, technology, reconnaissance, training, and research; and through resourcing Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities, (DOTMLPF) solutions. Part of the JIEDDO mission is rapid acquisition of the needed equipment materiel solutions. Each of the initiatives can be valued up to $25 million by the director of JIEDDO. Once developed, if proven initiatives are effective in use, JIEDDO is responsible to develop a plan for transitioning needed equipment materiel solutions to a POR for sustainment and further integration into the DoD system (DoD, 2006).

In November 2011, the AWG became part of the U.S. Army Training and Doctrine Command (TRADOC). The U.S. Army developed the AWG to assist in the transformation of the Army and to provide operational support of the Army and Joint Force commander (Office of the Director of the Army Staff, 2012). During the predeployment phase and while in the theater of operations, the AWG functions to enhance survivability and combat effectiveness of the soldiers. The AWG provides analysis, observations, and advisory support to the Army and the Joint Force to enable the defeat of asymmetric threats and methods.

As part of their mission, the AWG deploys worldwide, observing and analyzing evolving threats. From these observations in an operational environment, solutions are developed, capability gaps are identified, tactical observations are translated into Title 10 policy, and resource

implications are addressed. The AWG has forward-deployed operational cells that are responsible to target enemy vulnerabilities through the development-and-solution validation. These cells also enhance situational awareness (Office of the Director of the Army Staff, 2012).

The AWG has a partnership with the JIEDDO in the counter-IED fight. Continuous coordination ensures that efforts are complementary and not redundant. In addition, the group works with the offices of other agencies in the defeat of asymmetric threats. It also has a presence in each of the combatant commands; this allows it to have first-hand observations. The AWG personnel have the ability to identify enemy tactics as well as their techniques and action, because they embed with the operational units while conducting missions in the area of operations. The AWG also provides advisory assistance to units prior to deployment in an effort to mitigate the threat (Mis, 2011).

Because of operations in OEF and OIF, the Army began to emphasize the need to respond to urgent needs of the operational units. While the equipment deployed by the Army generally met mission requirements, new threats were emerging that required different capabilities to counter the threat quickly. The acquisition system, with its perceived cumbersome and deliberate processes and budget system did not allow quick acquisition to fill the capability gap. As a result, in October 2002 the Vice Chief of Staff of the Army established the REF. The organization was funded by Overseas Contingency Operations (OCO) money. The REF is a staff support agency assigned to the Army G3 (United States Army, n.d.). According to retired Army General Peter J. Schoomaker, the intent of the REF efforts is to "improve mission capability while reducing risk to our soldiers."

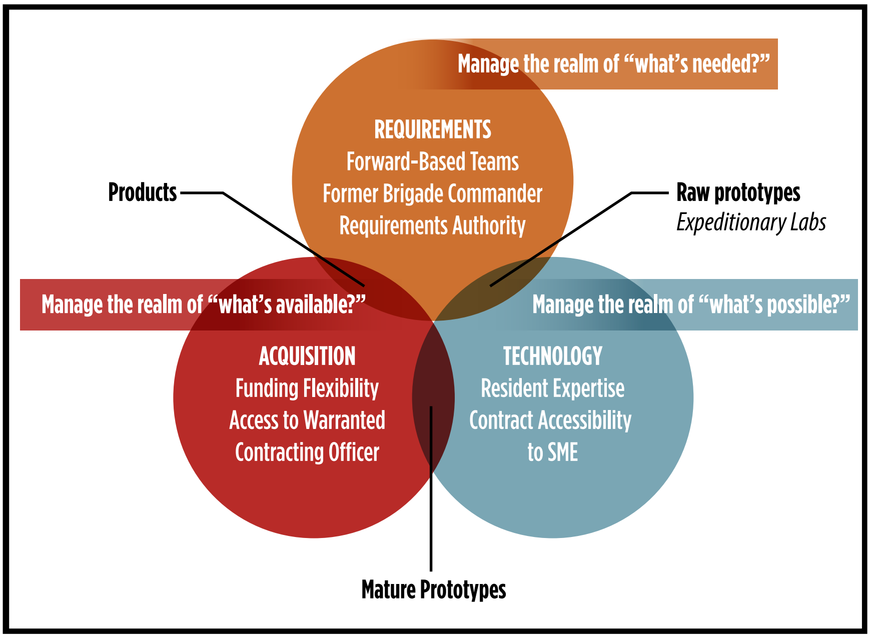
The primary purpose of the REF is to provide COTS of near-term developmental items—usually Technology Readiness Level (TRL) 6 or better—to satisfy urgent needs identified by operational units in OEF and OIF. A TRL rating falls on a 1–9 scale, with 1 being a concept study and 9 a fielded capability. The REF works directly with the commanders in the field to determine solutions that will meet the need. Once the REF identifies a solution, a limited quantity of the item designed to meet specialized capabilities goes to specific operational units. These solutions are not items that are currently available in the Army logistics system (Beasley, 2010a).

The solution selected must meet the operational need. As depicted in Figure 2, the REF's critical capabilities focus is on what is available, what is possible, and what the warfighter needs. Equipment sent to the field sometimes has limitations. A 90-day goal is set for meeting the requirement and developing a solution. Drawbacks, however, are inherent to equipping troops quickly with systems, especially those systems that have yet to complete all required testing to meet environmental conditions. Soldiers identify flaws in a system once these systems are used in the operational environment. A degree of risk is associated with equipping deployed units with new equipment in the abbreviated timeline—weeks and months versus years. Figure 3 compares the normal acquisition timeline that is used to "field" new systems of equipment versus "equipping," which is a rapid solution to a capability gap. As stated on the REF Web site, "the Commander, Central Command endorsed the notion of immature prototypes that could be made available quickly. A 51 percent solution is good enough" (United States Army, n.d.). The other primary differences are that under normal acquisition, more documents are required to complete the process and different sources of funding. Documentation such as the Initial Capabilities Document (ICD), CDD, and CPD are all required before fielding a normal acquisition program.

The personnel assigned to the REF work directly with the soldiers in the operational environment. Update of requirements occurs through exposure to soldier requirements (Beasley, 2010a). The REF personnel are actively participating in the operational environment, and developing requirements and solutions in real-time versus waiting for submission of requirements and monitoring their progress through the normal chain of command. Solutions bypass many of the normal acquisition and decision-making processes, and the units are equipped in a much shorter time. One drawback of this approach is that other units may not be aware of a solution, which they may also need.

In January 2013, the Chief of Staff of the Army announced that the REF would become a formal Army organization (INSIDEDEFENSE.COM, 2013). The REF is an organization that adds value to the acquisition process by developing equipment and equipping units with materiel solutions using an abbreviated acquisition timeline.

**FIGURE 2. RAPID EQUIPPING FORCE CRITICAL CAPABILITIES**




The Rapid Fielding Initiative (RFI) is an Army program that ensures the rapid procurement of equipment provided to soldiers who are deploying. The equipment is generally individual and unit equipment. The RFI development was in response to shortages of supplies at the beginning of OIF in 2002. The current budget did not allow soldiers and units to have needed equipment available when they deployed, and the timeline for receiving the equipment was too long. The units' soldiers were procuring the equipment themselves (Carter, 2007). Becoming aware of the equipment shortages, the Chief of Staff of the Army directed "the Program Executive Officer for Soldier Systems (PEO Soldier) with equipping all soldiers with the Soldier as a System Integrated Concept Team equipment list to support both OIF and OEF" (Carter, 2007).

The RFI leverages existing procurements, COTS items, and lessons learned from OEF and OIF. It also distributes mission-essential equipment to every soldier deploying to the theater of operations. The mission, which ended in 2007, is now continuing indefinitely. Originally, the RFI focused on unit-based fielding, but has shifted to "role-based fielding, which considers each soldier's function and each unit's mission when planning and

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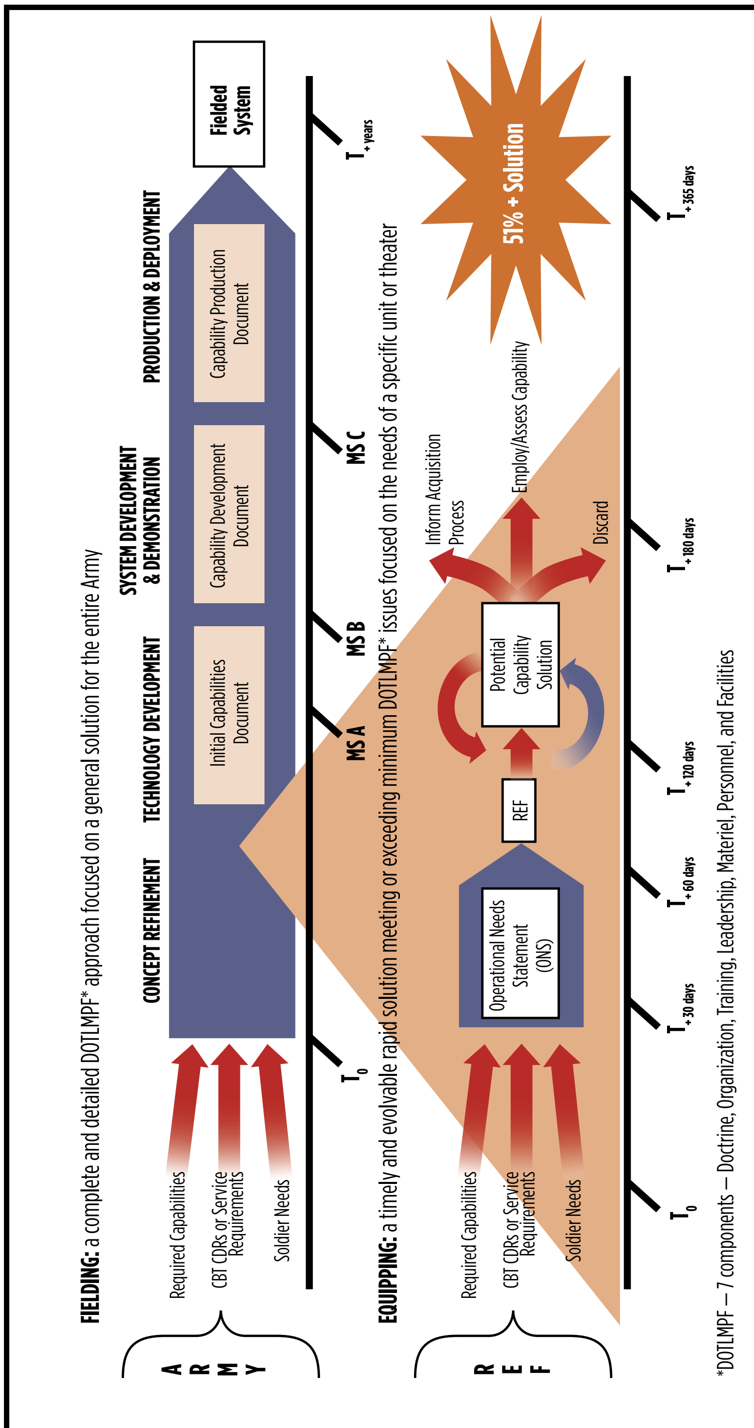
FIGURE 3: FIELDING VERSUS EQUIPPING



executing predeployment fielding" (DA, 2009b). Further, the reduction of turnaround time for getting needed supplies and equipment to the foxhole has been reduced from months and years to days or even weeks.

Another organization involved in the identification of future force needs is the Army Capabilities Integration Center (ARCIC). As stated on their Web site, the "ARCIC is subordinate to TRADOC, which develops, educates, and trains soldiers, civilians, and leaders; supports unit training; and designs, builds, and integrates a versatile mix of capabilities, formations, and equipment to strengthen the U.S. Army as America's Force of Decisive Action" (ARCIC, n.d.). The ARCIC also develops concepts, providing strategic and operational direction, and evaluates capabilities needed for the future force in operational environments in support of combatant commanders.

Concepts are the efforts that the Army must exert that allow the development of specific capabilities the Army needs to provide land power to the Joint Force commander. Solutions to provide needed capabilities may cross one or more of the components of DOTMLPF (ARCIC, n.d.). According to a GAO (2011) report, the ARCIC is involved primarily in tracking and the transition, transfer, or termination of a program generated by an urgent need (GAO, 2011). The ARCIC , as described in TRADOC Regulation (TR) 71-20, is also responsible to conduct the CDRT initiative (DA, 2013).

## The Urgent Materiel Release (UMR) Process

The materiel release procedures are prescribed in AR 700-142 (DA, 2008). Even though an item is filling an urgent capability shortfall, the process endures. Materiel release is required for all nonexpendable materiel; high-density military expendables; materiel procured by the Defense Logistics Agency; jointly developed materiel; materiel procured by another Service; and software or block updates.

The process and procedures for materiel slated to fulfill an urgent requirement constitute an abbreviated process called Urgent Materiel Release (UMR). The materiel will be required to meet minimum safety requirements and be suitable for use based on a validated user request or a directed requirement. To receive a UMR, the following data are required: requirement documentation such as the ONS or DA-directed requirement memorandum; a safety and health data sheet with a risk assessment; airworthiness statement; program manager (PM) request for

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user acceptance; transportability statement; explosive ordnance device statement; transportability statement; and Army Test and Evaluation Command (ATEC)/Developmental Test Command input (Dunn, 2013).

Seven votes are required from the Materiel Release Review Board members to recommend approval of a UMR. The UMR must indicate any capabilities, limitations, hazards, and restrictions labeled on the equipment. An item deployed to the field for satisfying a particular need because of an ONS is an approved UMR; approved use of the item is for that need only. The UMR, once granted, is valid for the duration of the conflict in theater. However, updated safety and airworthiness certifications are required each year. Once the equipment is received, the user must provide an acceptance statement. If the piece of equipment is deemed useful somewhere else, the creation of a new ONS is required; and it must process through the materiel release process to receive a release prior to fielding. It is important to note that most of the equipment fielded has a TRL of 6 or 7 (Dunn, 2013). At TRL 6–7, demonstration of the system in a relevant operational environment has been done (DoD, 2011).

## Capabilities Development for Rapid Transition (CDRT)

In August 2010, Secretary of the Army John M. McHugh signed an interim policy along with procedural guidelines for the management of rapidly fielded systems of equipment that have been designated as sustain, terminate, or transition to a PM for overall management. The decision process for the disposition of these systems was through the CDRT. The CDRT is a quarterly process used within the Army to identify the best of the nonstandard materiel and nonmateriel insertions that the Army should consider as enduring (Thomson, 2011). As was mentioned earlier, the CDRT is an ARCIC function. The equipment covered under the CDRT process is for commercially procured, nondevelopmental equipment or nonmateriel insertions. All of the equipment procurement occurs outside of the normal DoD budget resource process (McHugh, 2010).

The CDRT defines the equipment to be one of three categories: sustain, terminate, or APC enduring transition. Figure 4 provides a definition of each of these categories.

The CDRT process has five major steps: identify, assess, recommend, validate, and approve. Figure 5 further maps the elements of each step sequentially.

**FIGURE 4. CAPABILITIES DEVELOPMENT FOR RAPID TRANSITION PROCESS CATEGORY DEFINITIONS**

| **Acquisition Program Candidate or Enduring Nonmateriel Capability** |
|---|
| Fills current operational need, theater-proven, is applicable to entire Army and to Future Force |
| Enters JCIDS process at Milestone B or C, or merges into existing program |
| Intended to compete in Program Objective Memorandum |
| Sustain with bridge resourcing strategy through OCO funding |
| **Sustain Capabilities** |
| Fills a current theater operational need, but no broad application to entire Army or useful to Future Force |
| Not recommended as acquisition enduring capability at this time – theater use only |
| Sustain in theater with OCO funding |
| Conside HQDA-directed nonstandard equipment disposition |
| **Terminate Systems** |
| Does not fulfill intended function adequately or performs unacceptably |
| Is obsolete, a better alternative is available, or it is being replaced now by an approved system |
| Further development and support not warranted |
| Not sustained by HQDA funding, but may be retained by unit and supported with unit funding (Exception: battle command systems must be turned in immediately) |

*Note.* Adapted from "Switchblade: Lethal Miniature Aerial Munition System," by Accelerated Capabilities Division, Army Capabilities & Integration Center, Joint-Base Langley-Eustis, VA, 2012.

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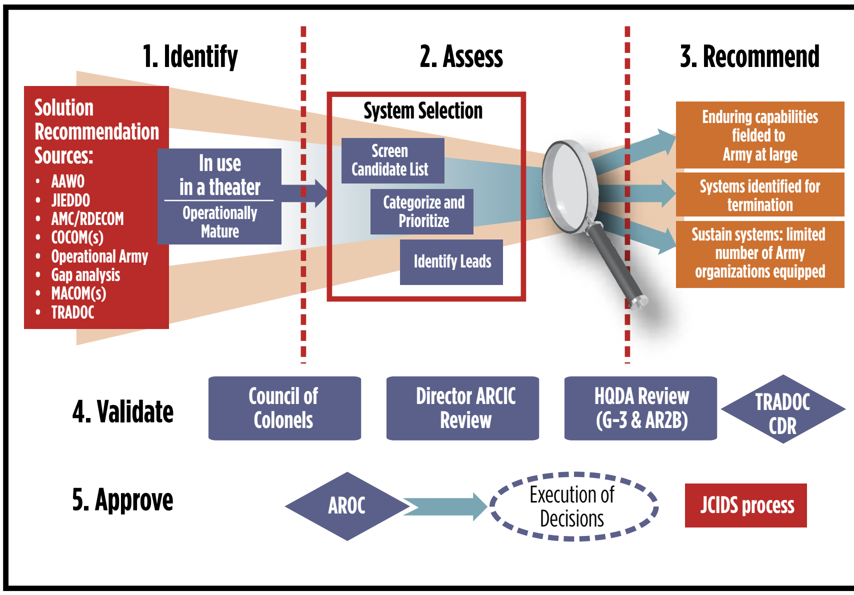
**FIGURE 5: CAPABILITIES DEVELOPMENT FOR RAPID TRANSITION PROCESS**

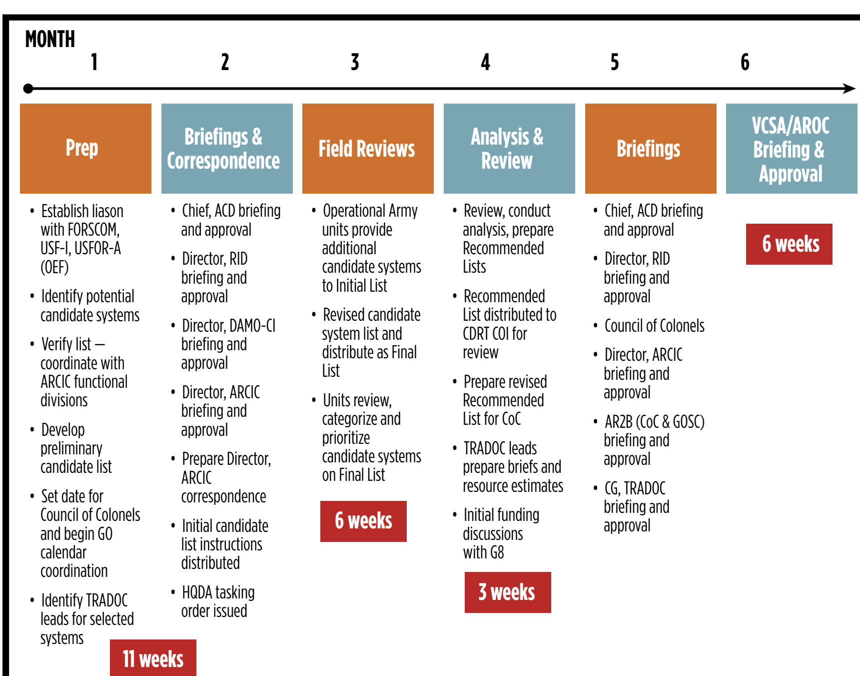



*Note.* Adapted from "Concept Development, Capabilities Determination, and Capabilities Integration," TR 71-20, U.S. Army Training & Doctrine Command, Joint Base Langley-Eustis, VA, 2013.

To summarize the process, several major Army organizations are stakeholders in the CDRT process, including Office of the Secretary of Defense/Joint Staff: Combatant Commands; operational theaters: Army G1, G2, G3/5/7, G6, and G8; Forces Command; AMC; ATEC; and TRADOC. The process operates on a 6-month schedule. Identification of programs for review occurs during the first and second month. The notional schedule includes 1 month of preparatory work that assists in establishing liaisons with major organizations. The second month consists of briefings and correspondence, followed by a month of field reviews of the potential candidates identified to assist in the prioritization of systems. In the fourth month, assessment, analysis, and review of the recommended candidate list occurs along with initial funding discussions with the G8. Validation, briefings, and a Council of Colonels (CoC) occurs during the fifth month. Also during the fifth month, ARCIC, the commanding general, and TRADOC are briefed and provided recommendations for approval of the CDRT decision. To close out the cycle, in the sixth month briefings are presented to the Vice Chief of Staff for the Army (VCSA) and the Army Requirements Oversight Council (AROC); these authorities then provide their approval, if recommended. Figure 6 is the notional schedule reflected on a timeline with additional details of the actions that occur during the 6-month CDRT process (TRADOC, 2012).

Early in the process, a working group compiles a list of candidate systems. The criteria for CDRT eligibility are that the system must have been used by an operational unit in theater for a minimum of 120 days, fulfill a current need, and be applicable for the future force. Also, as further expanded by TR 71-20 (DA, 2013), the items must also be producible without major modifications and not part of an existing acquisition program. Operational assessments must have been conducted. The Director of ARCIC approves the initial list. The approval by ARCIC finalizes the list, and it is then voted on by operational units to make the system an APC, sustainment program, or determine whether it should be terminated. If the operational unit has not used the system, then they vote that they have not used the system (DA, 2013).

**FIGURE 6. CAPABILITIES DEVELOPMENT FOR RAPID TRANSITION NOTIONAL SCHEDULE**




*Note.* Adapted from "Draft Capabilities Development Requirements Transition," by U.S. Army Training & Doctrine Command, Joint Base Langley-Eustis, VA, 2012.

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The CoC will review the compiled list. During the CoC, approval of the list occurs, and it then becomes the recommended list. Next, the AROC, chaired by the VCSA, is briefed for approval of the candidate items (Popps, 2008). With the approved list, Headquarters, Department of the Army (HQDA), through TRADOC, will task the schoolhouse or the combat developer to produce JCIDS documentation. Funding for the approved APC programs is not an automatic occurrence, but the system at this point would now be eligible to compete for needed funding.

Although validated ONS are sufficient for wartime or short-term efforts, the transfer to a formal acquisition program requires implementation of the JCIDS process to validate requirements. A provision in the CJCSI 3170.01 allows later entry into the defense acquisition life cycle for successfully performing systems. Often systems enter at the production phase. This provision includes nonstandard systems (CJCS, 2012).

Concerning the JCIDS process, AR 71-9 clearly states that the JCIDS development cycle may be reduced through use of the CDRT process. Analysis conducted may include operational assessments, an operating force survey, a subject matter expert assessment, HQDA-level CoC recommendation, and determination of a broad applicability; further, the combat developer (CBTDEV) may prepare a CPD. If the analysis conducted determines there is broad applicability, but that further development prior to transitioning to an acquisition program is required, CBTDEV may initiate a CDD (DA, 2009a). The regulation directs transfer of APC systems to the PEO or PM for life-cycle management. It is important that the transferring agency conduct initial coordination with the PEO or PM. Early coordination between rapid equipping agencies—such as the REF, PEO, or PM—is necessary for successful transfer. Once agreement is reached between the two groups, the Deputy for Acquisition and Systems Management, along with an official transfer memorandum signed by the ASA/ALT, assigns life-cycle management responsibilities to the designated PEO. A Memorandum of Agreement (MOA) between the equipping organizations such as the REF is developed, which will further define responsibilities, provide system information and programmatic documentation, and detail fund profiles (Popps, 2008).

Sustainment of APC systems in theater is with OCO funding. They will remain funded by OCO until Future Years Defense Plan (FYDP) funding is in place. Further, OCO and/or Reset funding is initially appropriate to perform retrograde if the equipment is returned prior to JCIDS documentation being in place. The transition to the PEO or Life Cycle Management Command must occur quickly so that FYDP funding is not in jeopardy (McHugh, 2010).

***Funding for sustainment of nonstandard equipment is different, and AMC or U.S. Army Medical Command (MEDCOM) is responsible for life-cycle management, budgeting, and programming for sustainment funding.***

Funding for sustainment of nonstandard equipment is different, and AMC or U.S. Army Medical Command (MEDCOM) is responsible for life-cycle management, budgeting, and programming for sustainment funding. Some items may transfer to a PEO/PM for life-cycle management, resourced via supplemental appropriations (e.g., OCO). Once supplemental funding ceases to be available, the Army eliminates the use of sustainment items or these items will be required to re-compete via the CDRT process to become an APC maintained with Operations and Maintenance (O&M) funding. The originators, such as the REF, JIEDDO, AMC, or MEDCOM, complete a sustainment transfer plan. For those items in the sustainment category procured by the units, the units are responsible to develop an MOA with either the AMC or PEO/PM for sustainment actions. Units are not authorized to fund sustainment activities (McHugh, 2010).

Terminated items are no longer eligible to fill the same capability gap. Nevertheless, authorization of sustainment is possible for terminated items in theater if it fulfills another requirement and at some later point in time, will process through the CDRT as a redesignated item in a different category. Further, asset disposal, when no longer being used in theater, will be in accordance with existing regulations (McHugh, 2010).

Because of the CDRT process, if the item is designated as a retention item and becomes an APC or sustained, the item is required to go through a full materiel release. In addition to those items required for a UMR, additional actions required include analysis of how management of

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spares will occur, what the planned stock age levels will be, configuration management, and additional testing required prior to reuse. Assignment of Type Classification (TC) is another event (Dunn, 2013).

The TC is a process used to determine the level of acceptability of materiel for Army use. It integrates the acquisition process with the logistics processes. The TC provides data for logistics support, procurement, and other authorizations (DA, 2008).

## Acquisition for Operational Needs Statement (ONS) Requirement

According to a Blue Ribbon Panel briefing regarding acquisition reform, indications are that acquisition for urgent needs generally has limited sources from which to procure, with limited competition (DSBTF, 2009). In fact, as previously mentioned, the ONS package may include a materiel solution. Considerations regarding Operations and Sustainment (O&S) such as life-cycle cost are secondary considerations in meeting an ONS requirement, and the contractor often provides them.

The process to meet an ONS requirement may allow a single prototype to go straight to production. For an ONS, requirements' costing is usually just preliminary, but sufficient enough to attain an allocation of resources. Systems engineering and testing for capabilities and limitations does occur for ONS procurements with limited documentation. An ONS requirement solution has limited performance assessments and root cause analysis (Beasley, 2010a).

For an urgent requirement, equipment selected to fill the capability gap may have a TRL of 6, and sometimes it may be materiel from science and technology programs. Preliminary Design Review for urgent requirements may only be ad hoc or limited.

An urgent requirement solution does not normally pass through Milestone A or B, so no certification for supportability is required in accordance with 10 United States Code § 2366a and § 2366b. Affordability assessments are usually not applicable to urgent need solutions.

Fulfillment of urgent need requirements means the acceptance of greater risk to provide a faster, usable capability to the warfighter. Addressing sustainment after the equipment is ready for deployment is normal for an urgent requirement (Beasley, 2010b).

## A Case Study of the Lethal Miniature Aerial Munition System (LMAMS)

***"LMAMS was my only option."***

***(Company Commander)***

The LMAMS program was a Joint Component-required capability. The designated sponsor was the U.S. Special Operations Command (USSOCOM), with the lead agent being the U.S. Army Special Operations Command. The designated cosponsor was the U.S. Air Force Special Operations Command. Figure 7 illustrates the LMAMS.

As early as 2004, the need had surfaced for a small, lightweight munition system, capable of engaging enemy targets on top of/over, behind, and around buildings beyond the line of sight. The Defense Advanced Research Projects Agency (DARPA) and Raytheon Missile Systems identified a potential solution with the introduction of the Close Combat Lethal Recon (CCLR) (Kelly, 2009).

Beginning in 2006, U.S. Army and Air Force troops conducting overseas operations continued to identify a capability gap that CCLR did not meet while trying to identify hostile forces during urban fighting, or along convoy routes traveled during missions. Lessons learned from Mogadishu, OIF, and OEF reflected a requirement for a system that would "support the requirement for an organic beyond small arms effective fire, day/night capable, lethal miniature aerial munition capability" (Kelly, 2009). A JCIDS study was conducted that analyzed small, tactical unit tasks, tactics, and capability requirements. The tasks were common to all small dismounted combat units.

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**FIGURE 7. LETHAL MINIATURE AERIAL MUNITION SYSTEM (LMAMS)**


Photo Credit: DoD photo by Tech. Sergeant Russell E. Cooley IV, U.S. Air Force (released)

The USSOCOM signed an ICD for the LMAMS capability on October 27, 2008. The approval of the CDD occurred 1 year later, on October 30, 2009. The CDD defined a materiel solution that allowed team-sized operational units to dominate asymmetrical and conventional threats in close combat. The CDD stated that there were four materiel solutions capable of providing a solution to the capability gaps identified. The first included a small missile, the second was an Unmanned Aerial Vehicle (UAV), the third was a lethal rotary wing micro-UAV, and a fourth concept was a ground UAV airdropped weapon. However, based on the CDD, "a man-launched precision weapon may also provide capability in a case where direct line of sight is available, but team-level weapons do not have the range, accuracy, and effects to neutralize a target" (Kelly, 2009). The Analysis of Materiel Alternatives (AMA) within the CDD concluded that the "lethal aerial munition provides good combat effectiveness and mobility, with all threshold requirements met." The AMA is an integral part of the JCIDS process.

The U.S. Army Maneuver Center of Excellence (MCoE) requested approval by TRADOC of the CDD in November 2009. The approval request processed through the ARCIC to the U.S Army G-3. Approval of the final CDD by USSOCOM occurred in March 2011.

The ACD, which is a division under ARCIC; AWG; and the Close Combat Weapon System (CCWS) PM developed the initial version of the Concept of Operations (CONOPS) in mid-2010, which would serve as an operator and training manual. The manual included a system description/specifications, emergency procedures, and operational/sustainment procedures. The ARCIC updated documentation later that year based on troop input and AWG findings. As indicated in Figure 8, the AWG establishes relationships with industry, user, PM, and lifecycle manager.

The Switchblade, manufactured by AeroVironment, met the LMAMS requirement and was used for the LMAMS operational assessment that was on the forefront. Essentially, the LMAMS is a guided missile, small enough to fit in a backpack, and capable of firing at a small target. The drone is a missile launched from a tube with cameras on board to scout an enemy position before soldiers send the information to the target.

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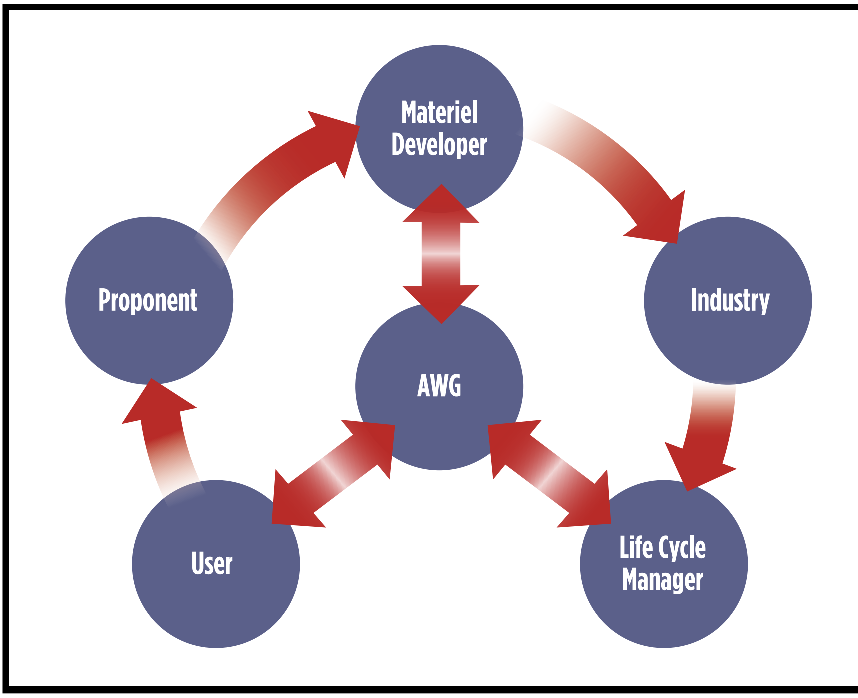
**FIGURE 8. ASYMMETRIC WARFARE GROUP RELATIONSHIPS**




*Note.* Adapted from U.S. Army Asymmetric Warfare Group, *Military Training Technology, 16*(1), by C. J. Mis, 2011.

An AWG operational assessment was conducted to determine the potential viability of the LMAMS to meet the performance requirements necessary to eliminate the capability gap. The intent of the assessment was to verify and validate the concepts of employment and Tactics, Techniques, and Procedures. Recommendations for improvement were also possible (AWG, 2011).

The AWG methodology would build on live fires and previous testing completed by the Air Force. The AWG personnel deployed with operational units in Regional Command-East to employ 10 LMAMS munitions in support of combat operations. Engagement criteria and employment concepts determined to which embedded units the AWG personnel would be assigned (AWG, 2011).

The conduct of field assessments transpired from February 2010 through December 2010 in the Continental United States and in theater. The objectives of the assessments were to collect information, including identification of improvements in the CONOPS, and to conduct a DOTMLPF review. Cost analysis was not included as part of the assessment of the Switchblade. Further, the report did not identify the Switchblade as the LMAMS requirement materiel solution.

The AWG conclusion showed LMAMS potential to provide small-unit capability to combat enemy insurgents. The LMAMS allowed units to avoid collateral damage and civilian casualties. Included in the AWG statement was that the LMAMS had significant potential as an enduring capability. The ACD recommended that the LMAMS "was a potential CDRT candidate, and to provide input for further JCIDS requirements development" (ACD, 2011).

A REF 10-Liner, submitted by a combat unit, came in for approval to the REF Milestone Decision Authority (MDA) in February 2011. A REF 10-Liner is a requirements document outlining the solution for an urgent need. In October 2011, the MDA approved the REF 10-Liner. The initial quantity submitted to the REF was to procure 75 units, accomplished via partnership with the CCWS PM and Program Executive Office Missiles and Space (PEO M&S). The REF provided funding to CCWS PM to develop, procure, test, train, and sustain the system for 6 months (ACD, 2011).

In early 2011, the findings of the AWG recommended the LMAMS as being the only option to respond to enemy fire in "Community of Practice" defense missions due to critical delay and time concerns. This situation proved the effectiveness of an organic weapon system, employed rapidly, while troops were in contact with the enemy and the situation was continuing to develop (AWG, 2011).

The activity on the Switchblade continued, and a contract was awarded for limited quantities of the Switchblade in June 2011. Initial training occurred in March/April 2012. Safety confirmation testing by ATEC occurred in June 2012. Action is now ongoing to prepare and staff the CPD and the acquisition strategy (Nichols, 2013). The goal for completion of the CPD is mid-FY 2014.

The staffing goal of the Maneuver Center of Excellence (MCoE) for the CPD to support a Milestone C decision is FY 2016. One important point—DARPA and the Raytheon Company provided the first demonstration of the LMAMS. The MCoE indicated that although the Switchblade

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by AeroVironment was the system used during various demonstrations and urgent equipping to the area of operations, the final materiel solution selected could be a different system. Also indicated, the MCoE agreed to leverage the existing ICD and CDD; therefore, developing the CPD for production would be the next action. A decision was based on results of the urgent equipping and lessons learned from the field. Further, LMAMS would be a candidate for CDRT in 2013 (Sando, 2012).

In January 2013, PEO M&S became the MDA. The Army Acquisition Executive designated the LMAMS as an ACAT III program (Shyu, 2013). According to LMAMS Product Director Bill Nichols, the LMAMS was scheduled on the agenda for the CDRT No. 17. In addition, the planned acquisition strategy will be a competitive procurement.

## The Counter-Rocket Artillery and Mortar (C-RAM) Experience

Another PEO M&S program fielded in response to an urgent need was the C-RAM program. Responding to the ONS made by the Multi-National Force–Iraq (MNF-I), the C-RAM initiative was taken to counter attacks by the enemy of rockets, artillery, and mortars. Insurgents were "employing indirect-fire tactics of quick-attack, low-trajectory, urban terrain-masked rocket, artillery, and mortar strikes against U.S." (Corbett, 2012) Forward Operating Bases (FOB) in Iraq.

In 2004, Marine General Anthony Zinni, then-Commander, U.S. Central Command, received a JUONS approval with funding for an indirect fire intercept capability. ATEC sponsored a "proof of principle" competition for the sense-and-warn capability. A second test increment occurred in the spring of 2005 to validate the intercept capability. ATEC issued a capabilities and limitations report. By May 2005, a complete system was in the FOB. The result was a system of netted sensors and shooters from the Army, Navy, and private industry, comprised of four pillars of active defense: sense, warn, intercept, and respond (Rassen, 2011).

The C-RAM is a system of systems consisting of four pillars. Each of the systems that comprise the C-RAM has its own POR. The interface makes the system of systems a C-RAM. The C-RAM is now embedded at the FOBs in Afghanistan and Iraq (Walker, 2011). It has been to the

CDRT and is recognized as an enduring requirement. Since its rapid fielding, the system has undergone multiple improvements in response to lessons learned.

## Rapid Acquisition and CDRT

Review of rapid acquisition and the CDRT process reveals some observations regarding both of these processes based on research documentation and interviews. Both processes—rapid acquisition and CDRT—grew out of an operational need. For rapid acquisition, it was a requirement to get equipment to the field faster than a normal acquisition program. CDRT grew out of a need to transition the rapidly acquired equipment into the U.S. supply system.

***The acquisition process and contracting are not set up to provide quick responses, and sometimes are seemingly nonresponsive to what is perceived by units as an urgent need.***

Threat, safety, budget, resources, and other factors drive many acquisition decisions. As a result, PMs are not always in control of the budget for rapid acquisitions. This certainly may handicap their programs, possibly in times of crucial decision making. The resources come from other organizations, and this makes it very difficult to manage successfully. Rapid acquisition does not work within the formal DoD budget process.

The acquisition process and contracting are not set up to provide quick responses, and sometimes are seemingly nonresponsive to what is perceived by units as an urgent need. Both of these processes are very deliberate and require not only providing a great deal of information, but also completing a great deal of required documentation. Additionally, sole-source requirements present a problem for acquisition. The lengthy documentation required for sole-source processing is time consuming. Further, updates to the Federal Acquisition Regulation (General Services Administration, DoD, & National Aeronautics & Space Administration, 2005) should include language to support contracting for materiel requirements to satisfy JUONS and ONS.

There was strong support for Integrated Process Teams to develop the materiel solution. Recognition by the REF of a materiel solution is a necessary component of a materiel urgent need, helping to gain support of the solution in theater. Additionally, the AWG is knowledgeable about the systems it sponsors, thus the group is able to prepare in-theater personnel and assets for what will be coming, while simultaneously remaining a strong advocate moving forward.

One issue surfaced when concerns were expressed regarding the rules of engagement for use of the weapon system: that the risk-averse fighting forces may be reluctant to use the system. Additionally, if leadership in theater does not embrace the system, then its acceptance at unit level will be problematic. Clear lines of communication are needed and time allowed for units to undergo orientation to, and training on, the system.

The CDRT process is not a final authority like the JCIDS. The current acquisition community focuses on the lengthy acquisition process. Further, current tenets prescribed for defense acquisition make delivery/acceptance of products difficult unless they have undergone the full complement of processes/actions required by the Defense Acquisition Framework. The enduring requirement APC will need to meet the required elements of the DoD 5000 series (DoD, 2003; 2008), and actions may be required to develop any incomplete JCIDS documentation. Further, the CDRT process does not culminate with the issuance of any documentation to support the decision for the equipment to be an enduring requirement, or that it should be considered a POR. Finally, when an enduring requirement recommendation occurs, no plans are currently in place to transition the requirement to a POR. Maintenance procedures, training methods, and sustainment practices would need to be documented.

The full complement of sustainment actions is often not complete. This could result in costly upgrades later. While the system was in the FOB, a contractor (most likely the original equipment manufacturer) often provided sustainment and training. The transition to organic support, if determined to be the best means, may be costly.

"We can't have programs of record that are measured in decades; we have to have some agility in our capability cycle times."

—Terry J. Pudas, Office of Force Transformation (Center for Strategic Leadership & Development, 2013)

## Conclusions and Recommendations

The normal course of a POR adheres to the Defense Acquisition Framework, meeting milestone after milestone of what appears to the casual observer as an endless stream of reports, testing, and documentation. The PM complies with the rules, regulations detailed in the DoD 5000 series, and the other tenets prescribed for defense acquisition (DoD, 2003, 2008; General Services Administration et al., 2005). Milestone schedules for an acquisition program may span the timeframe of a decade. Typically, programs slip to the right, grow in cost, and may have budget instability. Acquisition programs that span a decade of planning, developing, and producing invariably could contain obsolete technologies once fielded.

***Rapid acquisition of a solution for an identified capability gap to prevent the loss of human life is often required. Toward that end, a separate formalized acquisition process for urgent needs is also required.***

Rapid acquisition of a solution for an identified capability gap to prevent the loss of human life is often required. Toward that end, a separate formalized acquisition process for urgent needs is also required. This is not a novel idea; the DSBTF, in their 2009 report recommended a dual acquisition process (DSBTF, 2009).

For ONS solutions, completion of the JCIDS documentation can occur in parallel. The JCIDS documentation for the LMAMS is in development, the system is deploying to the field, and system improvements are developing while the system is actively engaging the enemy.

The establishment of timelines for completion of the milestone documentation for the urgent requirement solutions is required. For example, the goal for completion of the ICD is within 90 days of initiation of an ONS. Completion of documentation will allow for the timely transition to a POR.

The technologies for urgent requirement solutions are usually TRL 6 or greater. The system can continue to evolve after the rapid equipping via a development program or modifications. Evolutionary acquisition occurred with a great deal of success with the C-RAM system. The advantage of evolutionary acquisition is that the equipment is field-tested, changes needed because of actual field use are identified, and lessons learned provide valuable information to make any necessary improvements or changes. Action to modify JCIDS documentation is ongoing.

***The advantage of evolutionary acquisition is that the equipment is field-tested, changes needed because of actual field use are identified, and lessons learned provide valuable information to make any necessary improvements or changes.***

All the testing JCIDS requires is not always completed, but sufficient testing results are available to determine capability and identify system limitations. The UMR process ensures that the proposed materiel solution meets or exceeds safety requirements. Receiving units must acknowledge and accept any known operational employment risks that the ONS solutions may identify. If units can report successful use of the equipment in the operational environment, a reduction in the amount of testing required is a recommendation. This is especially the case for mature technology solutions. For instance, the MCoE felt comfortable going straight to Milestone C and entering the production phase for the LMAMS.

There should be established steps that lead to production and fielding. The steps should then transition to production and O&M funding. Early identification of resource requirements will allow for incorporation into budget planning documentation. Approval of an ONS should kick off the establishment of a budget line. Planning for sustainment funding should begin at that time as well.

The United States went to war in OEF and OIF, and the warfighter was ill-equipped to defeat some of the evolving threats the enemy brought into the operations. Urgent solutions continue to counter the threat; some are not perfect. What remained were the new enduring capabilities that had not completed the laborious and deliberate acquisition process. The CDRT process evolved to bring these capabilities into the system as PORs, but the process remains incomplete.

***The processes and procedures used to allow fulfillment of capability gaps by emerging technologies should continue because they can be effective.***

Using examples such as the success of the LMAMS and the C-RAM, both systems were initially put into operation as a Quick Reaction Capability (QRC) or an ONS, indicating that these systems were effective in meeting the threat prior to completion of engineering and manufacturing development. They would later continue on a path to become PORs. Technologies were evolving while the system was in use in operational environments, to address the capability gap. Systems such as C-RAM continue to be improved, long after their initial introduction to the field, based on lessons learned in OEF and OIF. The processes and procedures used to allow fulfillment of capability gaps by emerging technologies should continue because they can be effective.

Existing regulations and policy are acceptable in a proactive planning cycle, but are not adequate to meet urgent user needs. Research shows that rapid acquisition procedures are effective, and can yield long-term capability for the warfighter.

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# APPENDIX

## List of Abbreviations and Acronyms

**AAWO** . . . . . . . . . . . . . Army Asymmetric Warfare Office
**ACAT** . . . . . . . . . . . Acquisition Category
**ACD**. . . . . . . . . . Accelerated Capabilities Division
**ACOM**. . . . . . . . . . . . . . . Army Command
**AMA** . . Analysis of Materiel Alternatives
**AMC** . . . . . . . . Army Materiel Command
**APC**. . . Acquisition Program Candidate
**AR** . . . . . . . . . . . . . . . . . . Army Regulation
**AR2B** . . . . . . . . Army Requirements and Resourcing Board
**ARCENT** . . . . . . . . . . . U.S. Army Forces, U.S. Central Command
**ARCIC** . . . . . . . . . . . . . Army Capabilities Integration Center
**ARFOR**. . . . . . . . . . . . . . . . . . Army Forces
**AROC**. . . . . . . . . . . . Army Requirements Oversight Council
**ARSTA** . . . . . . Army Staff, Headquarters Department of the Army
**ASA(ALT)** . . . . . . . . . Assistant Secretary of the Army (Acquisition, Logistics & Technology)
**ASCC** . . . . . . Army Service Component Command
**ATEC**. . . . . . . . . . Army Test & Evaluation Command
**AWG**. . . . . . Asymmetric Warfare Group
**CBTDEV**. . . . . . . . . . . Combat Developer
**CCWS**. . Close Combat Weapon System
**CDD** . . . . . . . . Capabilities Development Document
**CDR**. . . . . . . . . . . . . . . . . . . . . Commander
**CDRT** . . . Capabilities Development for Rapid Transition
**CFSOCC**. . . . . Combined Forces Special Operations Component Command
**CIC** . . . . . . . . . . . . . . Commander in Chief
**CITF** . . . . . . . . . . . . Criminal Investigation Task Force
**CJCSI** . . . . . . . . . . Chairman Joint Chiefs of Staff Instruction
**CoC**. . . . . . . . . . . . . . . Council of Colonels
**COCOM** . . . . . . . . Combatant Command
**COI** . . . . . . . . . . . . Community of Interest
**CONOPS** . . . . . . Concept of Operations
**COTS** . . . . . . Commercial-Off-The-Shelf
**CPD**. . . . . . . . . . . Capabilities Production Document
**C-RAM** . . . . . . . Counter-Rocket Artillery and Mortar
**DA** . . . . . . . . . . . Department of the Army
**DAMO CIC**. . . . . . Office of the Assistant Deputy Chief of Staff G3/5/7, Future Warfighting Capabilities Division
**DCS**. . . . . . . . . . . . . Deputy Chief of Staff
**DoD**. . . . . . . . . . . Department of Defense
**DOTMLPF** . . . . . Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities
**DRU**. . . . . . . . . . . . . Direct Reporting Unit
**DSBTF** . . . . . . . . Defense Science Board Task Force
**FCB**. . . . . Functional Capabilities Board
**FD** . . . . . . . . . . . . . . . Force Development
**FOB**. . . . . . . . . . Forward Operating Base
**FORSCOM**. . . . . . . . . . Forces Command
**FYDP** . . . . . . Future Years Defense Plan
**GAO** . . . . . . . . . . . . . . . . U.S. Government Accountability Office
**GO**. . . . . . . . . . . . . . . . . . . . General Officer
**GOSC** . . . . . . . . General Officer Steering Committee
**HQDA**. . . . . . Headquarters Department of the Army
**ICD** . . . . . . Initial Capabilities Document
**IED** . . . . . . Improvised Explosive Device
**JCIDS** . . . . Joint Capabilities Integration and Development System
**JIEDDO** . . . . Joint Improvised Explosive Device Defeat Organization

**JUONS** . . . . . . . . . . . . . . . . . . Joint Urgent Operational Needs
**LMAMS** . . . . . . . . . . . . . . . Lethal Miniature Aerial Munition System
**MAJCOM** . . . . . . . . . . . . Major Command
**MCoE** . . . . . . . . . . . . U.S. Army Maneuver Center of Excellence
**MDA** . . . . . . . . . . . . . . Milestone Decision Authority
**MEDCOM** . . . . . . . . . . . U.S. Army Medical Command
**MNC** . . . . . . . Multi-National Corps – Iraq
**MNF-I** . . . . . . Multi-National Force – Iraq
**MS** . . . . . . . . . . . . . . . . . . . . . . . . Milestone
**NGB** . . . . . . . . . . National Guard Bureau
**OCAR** . . . . . . . . . . . . . . Office of the Chief Army Reserve
**OCO** . . . . . . . . . . . Overseas Contingency Operations
**OEF** . . . . . Operation Enduring Freecom
**OIF** . . . . . . . . . . Operation Iraqi Freedom
**ONS** . . . . Operational Needs Statement
**PEO M&S** . . . . Program Executive Office Missiles and Space
**POR** . . . . . . . . . . . . . . . Program of Record
**RDECOM** . . . . . . . . . U.S. Army Research, Development and Engineering Command
**REF** . . . . . . . . . . . Rapid Equipping Force
**RID** . . . . . . . . . Requirements Integration Division
**SME** . . . . . . . . . . . . Subject Matter Expert
**TC** . . . . . . . . . . . . . . . . Type Classification
**TR** . . . . . . U.S. Army Training & Doctrine Command Regulation
**TRADOC** . . . . . . . . . . U.S. Army Training and Doctrine Command
**TRL** . . . . . . Technology Readiness Level
**UMR** . . . . . . . . . Urgent Materiel Release
**U.S.** . . . . . . . . . . . . . . . . . . . . . United States
**USAREUR** . . . . . . . . United States Army, Europe
**USARPAC** . . . . . . . . United States Army, Pacific
**USASOC** . . United States Army, Special Operations Command
**USF-I** . . . . . . . . . . . . . . . U.S. Forces – Iraq
**USFOR-A** . . . . U.S. Forces – Afghanistan
**VCSA** . . Vice Chief of Staff of the Army

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**Keywords:** *Should Cost Management, Better Buying Power, Cost Savings; Cost Reduction, Affordability*

# Applications of Should Cost to Achieve Cost Reductions

*D. Mark Husband*

The initial version of the DoD's Better Buying Power (BBP) guidance directed use of "Should Cost Management" as a tool to increase efficiency and productivity in DoD acquisition programs. Over three years later, it is worthwhile to examine how programs have implemented Should Cost, the types of savings programs have identified and realized, and best practices and lessons learned that may be adopted or adapted by other programs. This paper provides selected Should Cost implementation examples from fifteen Major Defense Acquisition Programs (MDAPs) that have resulted in realized Should-Cost savings or initiatives that have an excellent chance of being realized. These programs employed various approaches based on the program's characteristics and phase within the acquisition life cycle.

*« Image designed by Diane Fleischer*

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## Should Cost Policy

In his original Better Buying Power (BBP) memorandum, Dr. Ashton Carter, then-Under Secretary of Defense for Acquisition, Technology and Logistics (USD[AT&L]), directed managers of each major program to implement Should Cost management to drive productivity improvements in their programs (Carter, 2010a). In his subsequent BBP Implementation memo, program managers (PM) of all Acquisition Category (ACAT) I, II, and III programs were directed to establish Should Cost estimates for programs as they are considered for Milestone (MS) decisions, and to track success of such initiatives in their programs (Carter, 2010b).

***...all of the BBP Initiatives are aimed at providing more capability without expending more dollars by improving productivity and eliminating excessive costs and unproductive overhead that have crept into DoD business practices over many years.***

The purpose of Should Cost is simple and rational—its aim is to “identify and eliminate process inefficiencies and embrace cost-reduction opportunities” (Carter & Mueller, 2011). Beyond this commonsense purpose, several factors motivated the introduction of Should Cost. A primary motivation, as stated in Carter’s (2010a) memorandum, is that spending to the Independent Cost Estimate (ICE) can become a “self-fulfilling prophecy” (i.e., “the forecast budget is expected, even required, to be fully obligated and expended”). Congressional interest was also a compelling motivator; Congress addressed the subject (without using the term Should Cost) in the 2011 National Defense Authorization Act through the following language:

> (a) cost estimates developed for baseline descriptions and other program purposes...are not to be used for the purpose of contract negotiations or the obligation of funds; (b) cost analyses and targets developed for the purpose of contract negotiations and the obligation of funds are based on the government’s reasonable expectation of successful contract performance in accordance with the contractor’s proposal and previous experience. (p.127)

Another motivation for Should Cost was the viewpoint that DoD's large budget increases after 9/11 and its focus on warfighter needs while waging two wars created inefficiencies that are unacceptable in today's fiscally constrained environment. Indeed, all of the BBP Initiatives are aimed at providing more capability without expending more dollars by improving productivity and eliminating excessive costs and unproductive overhead that have crept into DoD business practices over many years.

The following generalizations are based on the author's interactions with students while teaching Cost Analysis and Should Cost to hundreds of PMs and deputy PMs who attended the Advanced Program Manager's Course and Executive Program Manager's Course at the Defense Acquisition University (DAU) from 2010 to 2013. While the purpose and motivation for Should Cost have generally been well understood by the workforce, uncertainty and concern initially arose over how the concept would be implemented and executed. One source of confusion was the name. A "Should Cost Review" is an established term in Part 15 of the Federal Acquisition Regulation (FAR) § 15.407-4 that refers primarily to an extensive review of a contractor's operations to identify and promote more economical and efficient methods, and inform the government's negotiating position (General Services Administration, DoD, & National Aeronautics & Space Administration, 2005). "Should Cost," as directed by BBP, was intended to be simpler and more comprehensive; its objective is to seek efficiencies and productivity improvements throughout the acquisition Life Cycle by examining all cost elements, including government costs, acquisition strategies, and any techniques that could provide net savings. Another source of confusion during initial implementation was the difference between two of the concepts introduced by the BBP memorandum: "Affordability as a Requirement" *versus* "Should Cost." Consequently, the USD(AT&L) released a memorandum (Carter, 2011a) that explained the distinction between and compatibility of the two concepts: *Affordability* directs that quantified goals be established for unit and sustainment costs for DoD products (typically defined prior to MS B), driven by what the department can afford to pay, while *Should Cost* is a continuous effort to lower costs wherever and whenever it makes sense to do so. Thus, Affordability sets maximum costs based on budgetary considerations while Should Cost seeks the most economical acquisition of the procured item. Affordability drives prioritization and trades between requirements while Should Cost seeks the lowest possible prices once the Department decides what to acquire.

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Another concern about Should Cost implementation, which the author often heard expressed by PMs charged with executing the policy, is the potential to harm programs by making premature or unwise budget cuts based on projected Should Cost savings that have not been and may never be realized. This concern was foreseen during the formulation of the BBP Initiatives because the guidance memoranda all stress that Acquisition Program Baselines (APB) and budget positions shall continue to be based on Will Cost estimates. The policy for Should Cost savings established by the USD(AT&L) and Under Secretary of Defense (Comptroller) (Carter & Hale, 2011), specifies that Service Acquisition Executives (SAE) will declare when savings have been achieved, Service Comptrollers will validate that those savings have been realized, and such savings will generally be retained by the Service. Nevertheless, some program managers feared that Should Cost was another way to cut budgets, or that even if the DoD attempted to implement the concept smartly, Congress would cut program budgets based on Should Cost

estimates. As a consequence, program leaders were initially circumspect about publicizing their approaches and associated savings. As Should Cost implementation has matured, those fears have lessened and details of successful approaches are being more widely shared for several reasons. First and foremost, many PMs have found, sometimes to their own surprise, that significant amounts of money can be saved through Should Cost initiatives. Secondly, concern that such initiatives will be the impetus for budget cuts has waned, because in today's fiscal environment prudent acquisition managers are planning for inevitable budget cuts. Aggressively pursuing Should Cost initiatives enables the PM to get ahead of the power curve. Another reason approaches are being more openly shared is that Office of the Secretary of Defense (OSD) leadership has emphasized that the first priority and a primary purpose of Should Cost is to ensure that programs spend less than the Will Cost estimate and execute below their budget. Leaders recognize that, especially in the Engineering, Manufacturing and Development (EMD) phase, issues may arise that require additional funding; having a robust Should Cost program enables PMs to deal with unknowns and unfunded needs without asking for a budget increase. Should Cost savings thus make it more likely to execute a challenging program within budget. Finally, OSD leaders have consistently emphasized they don't expect every initiative to be successful; they want PMs to aggressively pursue multiple approaches, recognizing that some initiatives may not bear fruit.

## Finding Should Cost Savings

How should a PM and team identify cost-reduction opportunities and create a Should Cost estimate? Carter and Mueller's (2011)[1] article and the "Implementation of Will-Cost and Should-Cost Management" memorandum (Carter, 2011b) provide some general approaches on where to look for savings[2] and three methods for creating a Should Cost estimate.[3] These can be summarized:

- Look at the entire program, considering all costs.
- Look at examples from other programs, adopt best practices, and benchmark other programs.
- Look at the entire supply chain, considering not only prime contractors but also subtiers.

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- Look for program synergies, interdependencies, and opportunities to combine efforts with other programs. Carter's (2011b) guidance mentions integrating Developmental Testing/Operational Testing (DT/OT), but PMs should look for synergies and efficiencies anywhere possible.

- Look for opportunities during the program's risk assessment process. Carter's (2011b) guidance mentions identifying alternative technologies and materials, but any opportunities for savings should be explored. Unlike industry, which is driven by profits, government PMs often focus solely on risks and pay insufficient attention to cost-reduction opportunities.

How well have programs done applying Should Cost principles, identifying cost-reduction initiatives, and managing and executing to targets? A variety of approaches that have been successfully employed by DoD programs are described below. These examples were collected from Major Defense Acquisition Programs (MDAP), most of which presented their approaches to the USD(AT&L) in a Defense Acquisition Board or Defense Acquisition Executive Summary review. Besides being vetted by OSD leadership, the author discussed these examples with program office leaders (the PM or deputy), who concurred that the approaches and savings accurately reflect their program's results. While these approaches were derived from MDAPs, in most cases they are applicable to ACAT II–IV programs and could also apply to Major Automated Information Systems, Defense Business Systems, and services contracts. Including only MDAPs in the dataset was not intended to exclude other programs, but arose naturally because information on those programs is more readily accessible through the media and regular reviews by the USD(AT&L). Further studies on successful Should Cost approaches specific to information technology and services acquisitions are warranted.

## Should Cost Implementation Examples

This article's objective is to share successful Should Cost applications with the acquisition community. This requires defining what constitutes a "successful" Should Cost example. As described above, every DoD ACAT I–III program has been mandated to produce Should Cost estimates and initiatives. To distinguish between initiatives that have successfully achieved cost savings from those in their infancy or not yet initiated, the author created the following definitions for "*realized savings*" and "*projected savings*":

> ***Realized savings:*** Reductions in actual costs (outlays), signed contract value, or President's Budget position resulting from specific Should Cost initiatives, compared to a documented Will Cost estimate or approved APB or Program Objective Memorandum (POM).
>
> ***Projected savings:*** Documented estimate of savings for plans or proposals that have not yet been initiated, or projected life-cycle cost savings for efforts that have been initiated.

Although from a cost estimating perspective, a reduction in future budgets does not correspond to actual cost savings (particularly when work is not yet complete), the author believes these definitions provide a practical way to identify initiatives that have been approved by acquisition leaders and have yielded tangible results compared to those that may yield results in the future.

The Table provides a list of successful Should Cost approaches collected from 15 MDAPs during this study, which was conducted over 18 months beginning in October 2011. It illustrates approaches that have been adopted by multiple programs and the applicable acquisition phase for each approach. Space limitations preclude describing all these approaches in this article—additional briefing slides and a video presentation are available at DAU's Acquisition Community Connection Web site.[4]

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**TABLE 1. SHOULD COST APPROACHES WITH CORRESPONDING MDAPS, ACQUISITION PHASE, AND REALIZED AND PROJECTED SAVINGS**

| Should Cost Approach | Program | Acquisition Phase | Realized Savings*/FY | Projected Savings*/FY |
|---|---|---|---|---|
| Balancing affordability versus capability in design | *OHIO* | TDP | | ~$1B per sub |
| Applying Continuous Process Improvement Tools | *IAMD* | EMD | $53M/FY13-15 | ~$240M PROC ~$122M O&C |
| | *AIM-9X* | Production | $21M. Lot 11/FY11 | $82M/FY11-15 |
| | *F-18* | Production | $27M/FY11 | |
| Test program efficiencies | *Apache* | EMD | $35M/FY11-12 | N/A |
| | *GMLRS* | EMD | $33.6M/FY12-13 | |
| | *Stryker* | Production | ~$$7.7M/FY12 | |
| Reducing Schedule | *Apache* | EMD | NSP | |
| | *GMLRS* | EMD | NSP | |
| | *AIM-9X* | Production | NSP | |
| | *ViRGINIA* | Production | ~$2.4B/FY05-12 | |
| Competitive Source Selection that placed premium on price | *KC-46* | EMD & Production | $2.4B/FY11-16 | $428M by FY17 |

| Should Cost Approach | Program | Acquisition Phase | Realized Savings*/FY | Projected Savings*/FY |
|---|---|---|---|---|
| **Should Cost Analysis to inform negotiations prior to contract award** | *F-22* | Production | $32M/FY11 | |
| | *EELV* | Production | NSP | |
| | *DDG-51* | Production | NSP | |
| | *GMLRS* | Production | NSP | |
| **Tandem/Block/Bundle buys** | *E-2D* | Production | $73M, LRIP3 & 4/FY11-12 | |
| | *GMLRS* | Production | $52.3M/FY12-13 | |
| | *Stryker* | Production | $18M/FY11-12 | |
| **Multiyear Procurement#** | *C-130J* | Production | $610.6M/FY14-18 | |
| | *CH-47F* | Production | $373M/FY13-17 | |
| | *DDG-51* | Production | $319M/FY13-17 | |
| | *E-2D* | Production | $522.8M/FY14-18 | |
| | *F-18* | Production | $590M/FY10-13 | |
| | *UH/MH-60* | Production | $1051M/FY12-16 | |
| | *V-22* | Production | $852M/FY13-17 | |
| | *VIRGINIA* | Production | $1.04M/FY14-18 | |

| Should Cost Approach | Program | Acquisition Phase | Realized Savings*/FY | Projected Savings*/FY |
|---|---|---|---|---|
| Accelerating or more efficiently aligning production | *AIM-9X* | Production | NSP | |
| | *EELV* | Production | | ~$1.1B/FY14-18 |
| | *F-18* | Production | NSP | |
| Downselect changed to dual award based on price | *LCD* | Production | $2.9B/FY10-15 | |
| Sharing benefits of favorable financing | *E-2D* | Production | ~$1.5%/FY11-12 | |
| Maximizing competition through Profit-Related-to-Offer strategy | *DDG-51* | Production | ~$300M/FY11-12 | |
| Leveraging FMS for Economic Order Quantity buys | *AIM-9X* | Production | NSP | |
| Performance Based Logistics | *Apache* | O&S | $276M/FY11-15 | |
| | *V-22* | O&S | All O&S initiatives: 18% reduction cost/flying hr | |
| Increasing operational cycle; reducing depot time | *VIRGINIA* | O&S | | ~$1.4B/BY10 |
| Repairing parts that were previously consumable | *V-22* | O&S | NSP | |
| Incorporating automation to lower future manpower costs | *LCS* | O&S | NSP | |

*All savings in Then Year $ unless otherwise noted
#Based on CAPE estimate; Service estimated savings are generally greater
NSP: not separately priced

## Continuous Process Improvement Techniques

A proven methodology to identify and implement cost-reduction opportunities employs Continuous Process Improvement (CPI) techniques such as Fishbone Diagrams, Pareto (or histogram) Analysis, Plan of Action and Milestones (POA&M), and other tools as described in the "DAU Program Manager's Toolkit" (Parker, 2011). Three MDAPs examined in this study used CPI techniques to identify Should Cost initiatives: AIM-9X, F/A-18 E/F, and Integrated Air and Missile Defense (IAMD). Each of these employed a four-step process:

- **Step 1:** Identify the biggest cost drivers and most promising cost-saving opportunities.
- **Step 2:** Analyze and prioritize opportunities based on objective criteria.
- **Step 3:** Create plans of action and milestones for each opportunity selected.
- **Step 4:** Monitor and measure implementation progress and resultant savings.

Figure 1 depicts one of many Fishbone Diagrams created by the IAMD Program Management Office (PMO) in its effort to identify cost drivers and savings opportunities. The chart is only a small portion of IAMD's Step 1 efforts; for many of the opportunities shown in Figure 1, the IAMD PMO created additional, lower level fishbones that provided more detail about that opportunity, such as specific implementation actions and interdependencies with other efforts. When identifying opportunities, one should employ a multidisciplinary team, including industry participants if possible, to ensure a wide range of ideas are considered that take into account the entire system life cycle.

**FIGURE 1. FISHBONE DIAGRAM EXAMPLE FROM IAMD SHOULD COST ESTIMATE**

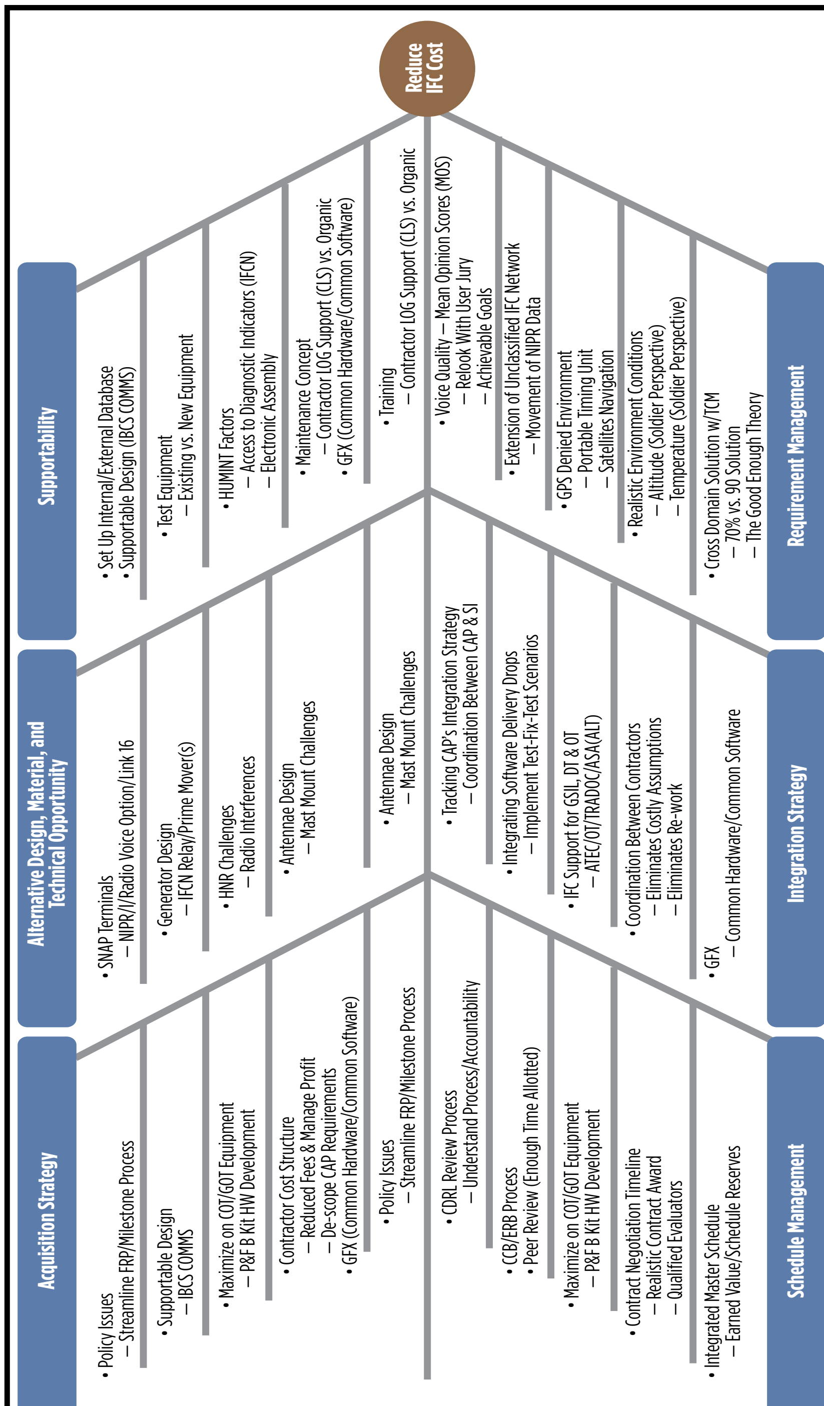

Figure 2 depicts a summary Pareto Analysis created by the AIM-9X PMO, which was the final result of their Step 2 efforts to analyze and prioritize opportunities. Again, this chart is only a small portion of those efforts. The team created multiple histograms that rank-ordered opportunities based on investment cost, ease-of-implementation, and implementation time. They also created weighting criteria, which allowed them to determine a quantitatively based overall ranking, as shown in Figure 2. A more detailed description of the complete methodology applied by the AIM-9X program was provided previously (Husband & Mueller, 2012).

Figure 3 depicts a POA&M chart created by the F/A-18 E/F PMO for one of their Should Cost initiatives; it shows by year the activities associated with the initiative and expected investment costs and projected savings. Creating such a plan is essential because it provides a tracking mechanism for determining when projected savings from initiatives are realized and thus available for other purposes. Developing metrics and trigger points to track each initiative is a best practice, because it increases the chances of realizing savings and provides the PM better situational awareness of the program's execution status and emerging issues.

Step 4 of the CPI methodology, tracking results as the initiatives progress, is arguably the most important step in realizing savings. Without a tracking mechanism and a means to evaluate results, the efforts to create and develop plans for Should Cost initiatives are likely to be wasted. Because Should Cost's primary goal is to increase efficiency and ultimately reduce costs, it is imperative that savings are tracked and reported.

## Test Program Efficiencies

Implementing test efficiencies was an approach employed by four MDAPs in this study: AH-64E Apache, Guided Multiple Launch Rocket System (GMLRS), IAMD, and Stryker. These programs found efficiencies through combined test events and better utilization of existing data. For instance, AH-64E's savings resulted from leveraging selected DT/OT events and utilizing combined contractor/government testing on events that were planned to be conducted independently. When asked whether streamlining the testing program increased program risk, Apache's PM said the Apache team consciously considered that

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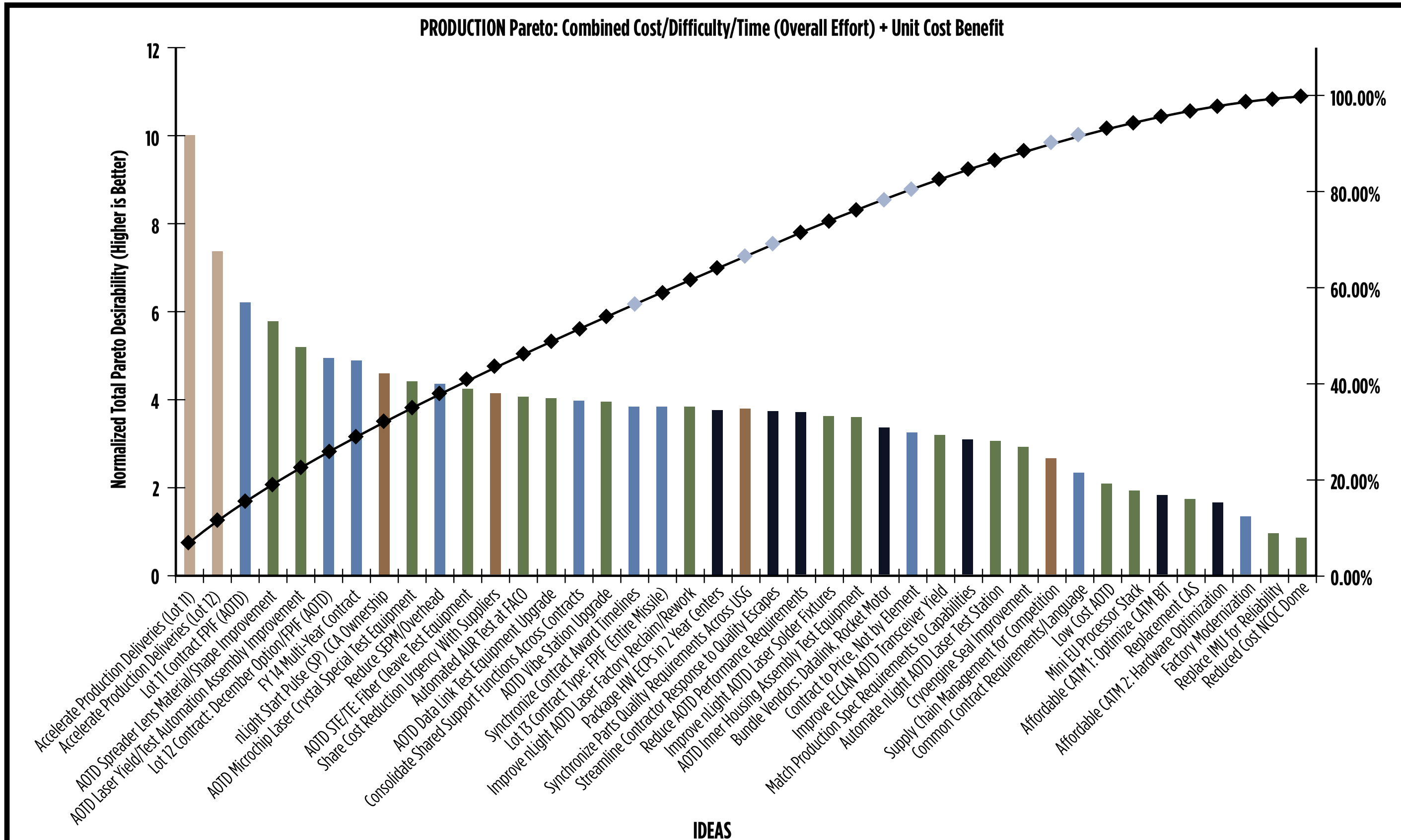
possibility and therefore vigilantly ensured that all tests required in the Test & Evaluation Master Plan were conducted. AH-64E also realized savings by using Modeling and Simulation (M&S) in lieu of live-fire testing of an aircraft.

The GMLRS program partnered with the Army Test and Evaluation Command to identify efficiency opportunities. Their approaches included eliminating redundant testing by identifying commonality in components, leveraging previous test data and M&S efforts, and conducting a risk-informed reduction in the number of flight test assets employed. The IAMD program partnered with a sister program office to plan a single flight test that met requirements for both programs. IAMD also resized their test program, based on an analysis of tests being conducted in several interrelated programs. Likewise, the Stryker program utilized existing data from contractor tests to satisfy government requirements and conducted combined testing of several subcomponents that previously would have undergone separate, planned test events.

## Multiyear Procurement and Tandem/Block/Bundle Buys

As shown in the Table, a number of MDAPs have realized significant savings through Multiyear Procurement (MYP) contracts, which allow use of a single contract to execute two to five years' worth of procurement. MYP requires congressional approval based on meeting several criteria in the governing statute, 10 U.S.C. § 2306b (Multiyear Contracts, 2011). (See O'Rourke & Schwartz, 2013, for discussion of MYP and Block Buy contracting.) Because some DoD and Service policy states that initiatives outside the PMO's control should generally not be considered as Should Cost initiatives, some uncertainty existed as to whether MYP-related savings should be included in a PM's Should Cost estimate. In practice, however, the use of MYP to lower costs has been included by several MDAPs as Should Cost initiatives in presentations to the USD(AT&L), and been well received. In general, the USD(AT&L) has been interested in any and all initiatives that improve efficiency and save money, including those that require congressional or Milestone Decision Authority approval. The UH/MH-60 PMO's success applying Should Cost principles to MYP negotiations was recently described by Vandroff and Kimble (2013).

**FIGURE 2. PARETO ANALYSIS EXAMPLE FROM AIM-9X SHOULD COST ESTIMATE**



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## FIGURE 3. PLAN OF ACTION AND MILESTONES EXAMPLE FROM F/A 18 E/F SHOULD COST ESTIMATE

| | Prior | | FY12 | | FY13 | | FY14 | | FY15 | | FY16 | | FY17 | | To Complete | | Total Savings | Saving $% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IRST EMD | Invest $K | Return $K | Invest $K | Return $K | Invest $K | Return $K | Invest $K | Return $K | Invest $K | Return $K | Invest $K | Return $K | Invest $K | Return $K | Invest $K | Return $K | | |
| **EMD Phase I** | | | | | | | | | | | | | | | | | | |
| Executed IRST EMD Contract (Roll-up) | | $2,000 | | $12,500 | | $14,250 | | $6,750 | | $2,500 | | | | | | | $38,000 | 22.0% |
| Fuel Tank Composition | | | | | | | | | | $300 | | | | | | | $300 | |
| Reduce OEM Support (Flight Test) | | | | | | | | | | $50 | | | | | | | $50 | |
| **Savings Realized** | | $2,000 | | $12,500 | | $14,250 | | $6,750 | | $2,850 | | $0 | | $0 | | $0 | $38,350 | |
| **EMD Phase II** | | | | | | | | | | | | | | | | | | |
| Schedule Acceleration (<Scope/POP) | | | | | | | | | | | | $1,050 | | $1,000 | | | $2,050 | |
| **Potential Savings Realized** | | $0 | | $0 | | $0 | | $0 | | $0 | | $1,050 | | $1,000 | | | $2,050 | |
| **Flight Test & Gov. Labor** | | | | | | | | | | | | | | | | | | |
| Performance Flight Optimization | | | | | | | | $3,700 | | $2,200 | | | | | | | $5,900 | |
| Live Fire Shot Reduction | | | | | | | | | | $1,730 | | | | | | | $1,730 | |
| Negotiated Gov. Labor Requirements | | $1,100 | | $750 | | $750 | | $600 | | $400 | | $500 | | | | | $4,100 | |
| MSI III Test Synergies (Flts, Missile Shot) | | | | | | | | | | | | $900 | | | | | | |
| Combine Performance/ECS Flights | | | | | | | | $300 | | | | | | | | | $300 | |
| Maximize use of M&S | | | | | | | | $200 | | $100 | | $400 | | | | | $700 | |
| King Air Flight Test (Refly Reduction) | | | | | | | | $500 | | $50 | | | | | | | $550 | |
| Schedule Acceleration | | | | | | | | | | | | $950 | | $500 | | | $1,450 | |
| **Potential Savings Realized** | | $1,100 | | $750 | | $750 | | $5,300 | | $4,480 | | $2,750 | | $500 | | | $15,630 | |
| | | | | | | | | | | | | | | | | | | |
| **Affordability Trades Realized - Baseline** | | $3,100 | | $13,250 | | $15,000 | | $11,050 | | $6,830 | | $500 | | | | $0 | $49,730 | 17.1% |
| **Total Should Cost Savings** | | | | | | | | $1,000 | | $500 | | $3,300 | | $1,500 | | | $6,300 | 2.2% |
| **Total Potential Savings** | | $3,100 | | $13,250 | | $15,000 | | $12,050 | | $7,330 | | $3,800 | | $1,500 | | $0 | $56,030 | 19.3% |
| **Total Investment** | $0 | | $0 | | $0 | | $0 | | $0 | | $0 | | $0 | | $0 | $0 | $0 | |

Investment
Excursion
Should Cost Saving
Affordability Trade/Should Cost Already Realized

*Each opportunity has specific key measurements and trigger points defining when funding will be realized.*

Although savings from MYP contracts are often significant, it can take several years lead time to complete the statutory criteria (including preparing an ICE and documenting savings). Therefore, several programs have adopted an alternative approach variously referred to as Tandem/Bundle/Block Buys, whereby the government solicits option prices for multiple lots based on planned purchases without making the firm commitment to buy that is a feature of MYP contracts. Three of the MDAPs studied realized savings through this approach: E-2D, GMLRS, and Stryker. In these cases, the PMO engaged with the contractor to obtain pricing based not only on a stand-alone current year production lot, but also lower priced options contingent on the government purchasing additional units the following fiscal year. Savings for these programs ranged from 4–7 percent, which is less than that of an MYP contract (for which the threshold is generally 10 percent), but nevertheless significant considering such savings result solely from negotiating prices for multiple lots rather than just the current year's lot.

Of course, without MYP contract approval, the government cannot commit that it will purchase units the following year. So why would a company offer lower prices for units in the current year, effectively at its own risk, based on the PMO's desire (but not commitment) to buy more units the following year? A rationale was provided to the author by the industry PM for the E-2D program. Particularly in today's fiscally austere environment, it makes business sense for companies to lower their cost structure and offer their products at a competitive price, especially when it results in more stable demand for those products. This author has heard many industry leaders cite predictable demand and long-term business arrangements as top priorities for their customer relationships, even more than profit margin. It thus makes good business sense for companies to take advantage of expanded customer demand by reducing costs and improving operational efficiency through investments in new technologies, tooling, utilizing economic order quantities, and long-term supplier relationships, etc. It also makes sense for companies to share benefits of those lower costs with their customers, further cementing a mutually beneficial supplier-customer relationship.

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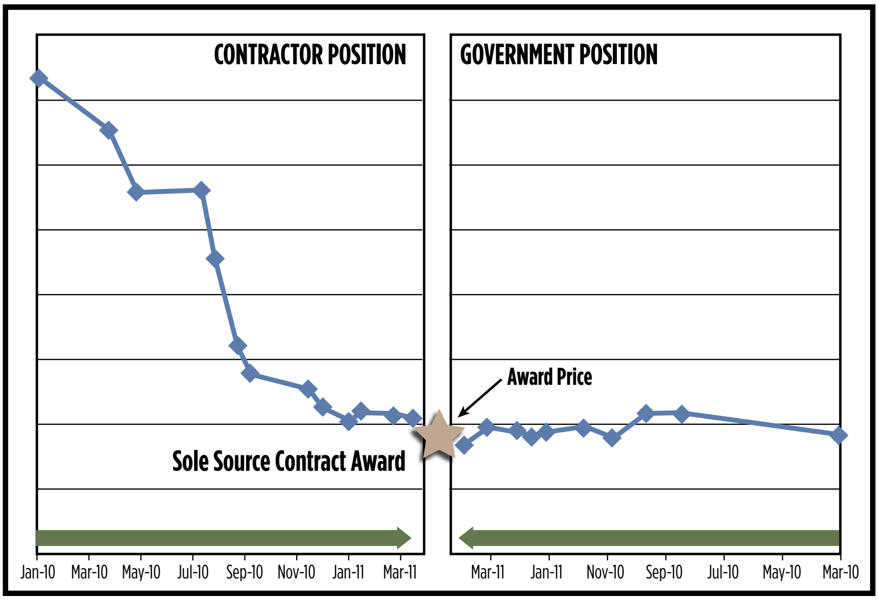
### Should Cost Analysis to Inform Negotiations Prior to Contract Award

As previously mentioned, BBP Should Cost is meant to be simpler than FAR Should Cost as described in FAR Part 15.4 (General Services Administration et al., 2013), which is primarily designed to inform the government's negotiating position prior to contract award. However, conducting a FAR-type review is an acceptable Should Cost approach and may be appropriate for programs that are preparing for a major contract award. Four MDAPs in this study conducted such reviews: F-22, Evolved Expendable Launch Vehicle (EELV), Guided Missile Destroyer (DDG-51), and GMLRS. These reviews ranged in size and scope, from a 50-plus member team that reviewed contractor documents, facilities, and processes for over 6 months to support negotiations on a ~$500 million contract, to a 6–8 person team that worked for 4–6 weeks to support a contract valued at less than $100 million. Several PMs observed that the reviews were about more than just Should Cost—they also provided a technical evaluation of contractor proposals that was useful for source selection and contract negotiations. Air Force Colonel Greg Gutterman (2013), F-22 PM, said:

> ...as a result of this analysis we identified math errors, overly conservative assumptions, and other items which helped us negotiate a $32M savings...I believe we've found a way to get a better business deal using our approach to the Should-Cost analysis. (p. 4)

The primary advantage of conducting a Should Cost review prior to contract award is that it provides critical knowledge to the government team, enabling it to negotiate smartly. The DDG-51 PMO had previously purchased over 60 ships from 1985 through 2005, so its PM had a very good understanding of the product's costs. However, the PMO team had not purchased a ship in 5 years and was confronted with a tough sole-source negotiating environment with their supplier. Conducting a thorough Should Cost analysis allowed the DDG-51 PMO team to ensure its understanding of costs and risks was appropriate. The ensuing negotiations, as depicted in Figure 4, were long and difficult, but ultimately saved the government hundreds of millions of dollars (compared to the company's opening bid). Obviously, not all PMs are in a position to negotiate a procurement action for so long—they might have to obtain support to shift their funding. However, in the case of DDG-51 the Should Cost analysis provided the government with enough confidence in its position that the Defense Acquisition Executive (DAE) and SAE engaged with Congress to ensure the program's money was protected throughout the protracted negotiations.

**FIGURE 4. PRICE CONVERGENCE DURING DDG-51 NEGOTIATIONS INFORMED BY SHOULD COST ANALYSIS**




## Schedule Reductions

Several programs found savings by streamlining and shortening their schedule, including Apache, GMLRS, and AIM-9X. If work can be compressed at acceptable risk, reducing the program's schedule is a straightforward, commonsense approach to increase program efficiency and lower overall costs, because it shortens the time one must pay for facilities and the "standing army," i.e., the contractor and government personnel working on the program. Of course, such an approach must be applied carefully to ensure the revised schedule is realistic and does not create unintended consequences. It isn't enough to consider just the feasibility and risks of compressing the planned effort, (i.e., can the work be done faster?); numerous other issues must be assessed, such as feasibility of realigning funding to support an accelerated schedule (is money available earlier to save money later?), availability of personnel and/or facilities (can the test plan really be altered?), and interdependencies with other programs (will a sister program's subsystem be available to support the revised schedule?).

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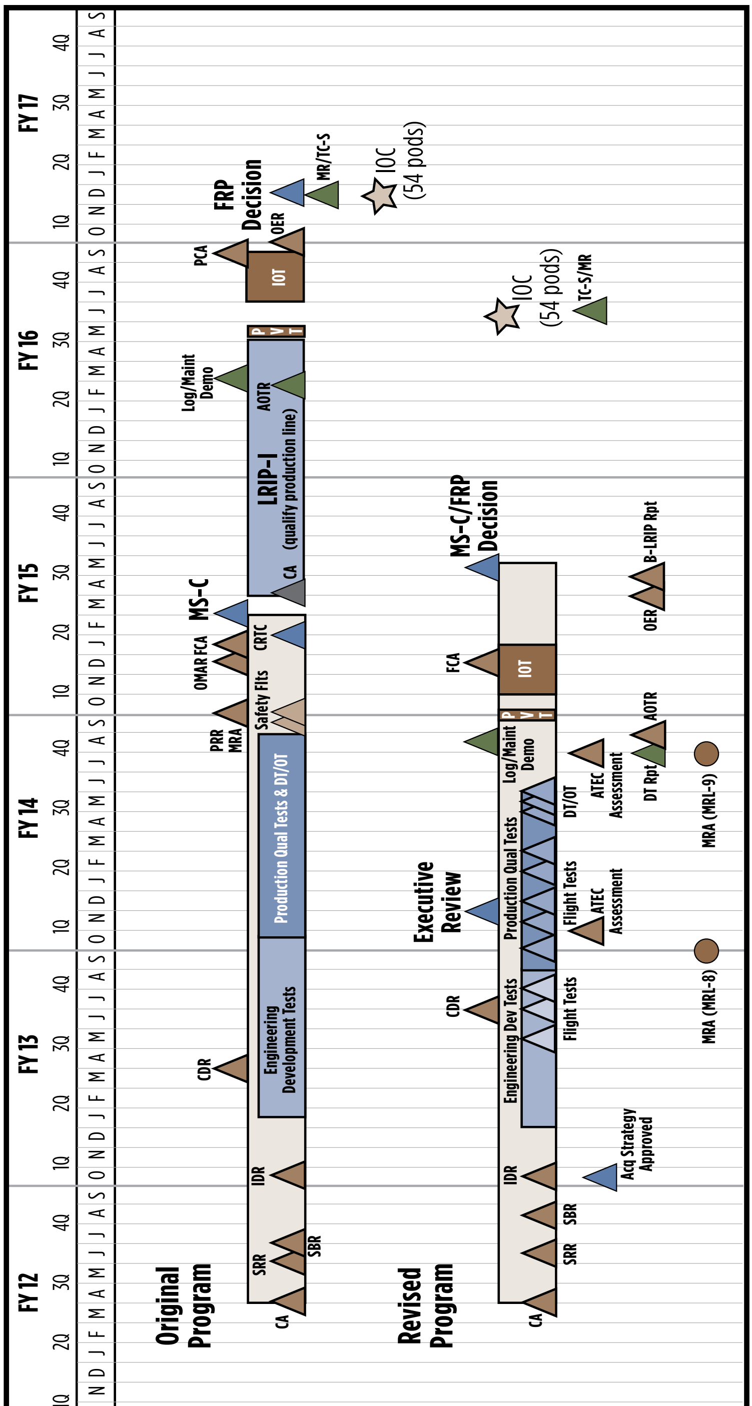
During their Should Cost effort, the GMLRS PMO carefully examined their entire planned effort, from MS B Contract Award to the Full-Rate Production (FRP) Decision, and reduced the original program schedule by 16 months (32 percent), as shown in Figure 5. Most of the reduction in the schedule resulted from the PMO's carefully considered decision to combine the MS C and FRP Decisions, based on their assessment that a mature production line would enable Initial Operational Test and Evaluation to precede MS C, obviating the need for an LRIP (Low Rate Initial Production) phase. Although eliminating LRIP might be only rarely applicable to other MDAPs, the GMLRS approach illustrates several positive features of a robust Should Cost review: "out of the box" thinking can yield significant savings, and the events and processes in Interim DoD Instruction 5000.02 (2013) are tailorable and should be streamlined based on a program's unique characteristics. Apart from eliminating LRIP, GMLRS also shortened its development schedule by using rockets from inventory to build test articles and, like Apache, through the DT/OT test efficiencies described previously. Schedule reductions can also be realized during production: Should Cost management enabled the AIM-9X contractor to reduce its missile build cycle from 12 to 8 months (i.e., 33 percent), in part through the PMO's timely award of the production contract in the first quarter of the fiscal year, which prevented a production gap. This is another illustration that significant savings can be achieved by prudent planning and prompt decision making and execution.

## Accelerating Deliveries/More Efficiently Aligning Production

The accelerated production just described for AIM-9X led to schedule reductions. Three other programs—EELV, VIRGINIA-class submarine, and F-18—each implemented accelerated or better aligned production to achieve savings. For instance, EELV obtained Service and DAE approval of their long-range procurement plan that considers the combined needs of the Air Force and other DoD and federal agencies for rocket cores from FY13–17 and beyond. According to EELV's PM, obtaining option pricing based on this procurement plan allows EELV to get many of the benefits of an MYP contract without MYP authorization. Much like the Tandem/Bundle/Block Buys approach described earlier, providing contractors with coordinated procurement plans across the government (even without a firm commitment to buy), enables contractors to obtain subcontractor commitments and provides savings through more economical (or at least stabilized and predictable) order quantities.

FIGURE 5. GMLRS REVISIONS TO PROGRAM SCHEDULE RESULTING FROM SHOULD COST ANALYSIS



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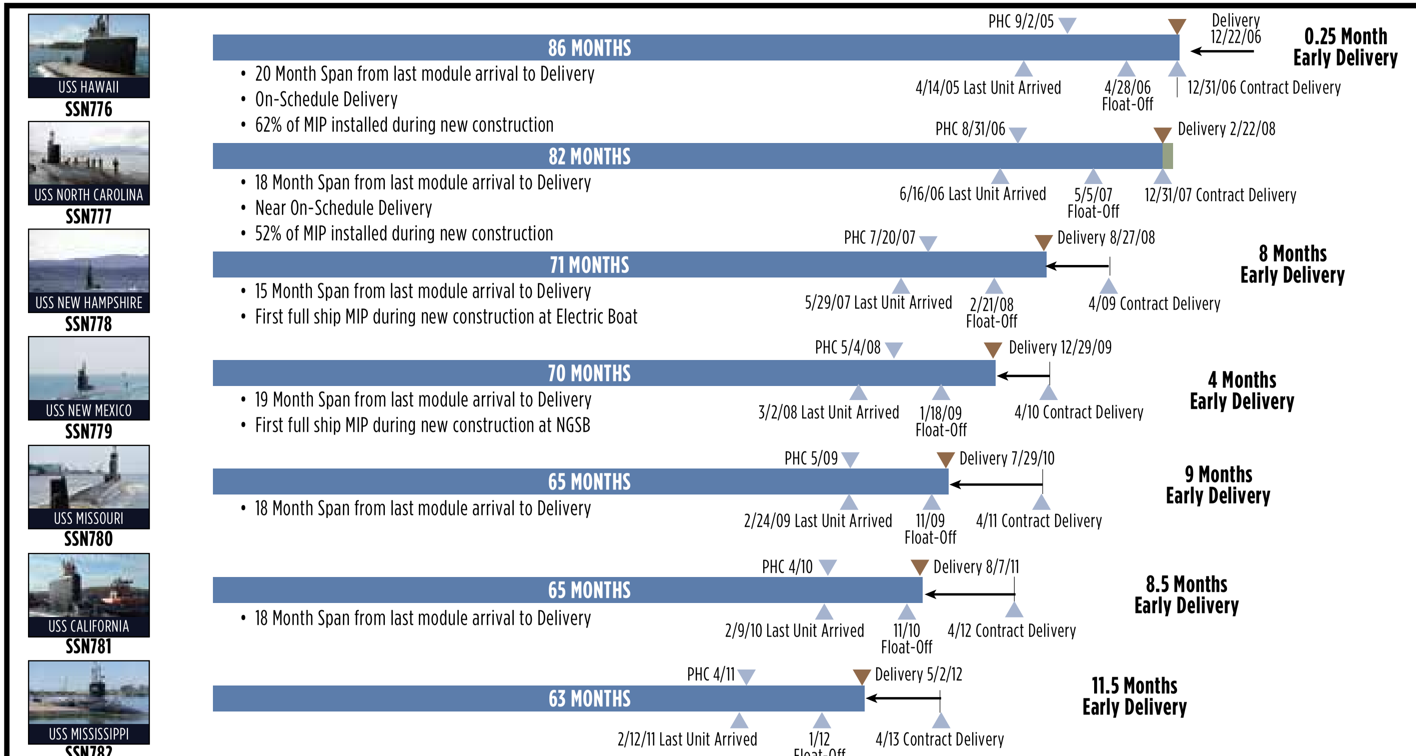
The VIRGINIA-class submarine program has conducted an active Reduction in Total Ownership Cost (RTOC) program that has continuously implemented design improvements and production efficiencies since the lead submarine was delivered in 2004. Major cost reductions were achieved by changing from a 10- to a 4-module build plan, and through cost-reduction initiatives in countless systems and subsystems (e.g., propulsion, main machinery, damping systems, paint and coatings, and many others). A striking illustration of the VIRGINIA program's RTOC success is shown in Figure 6, which depicts schedule reductions achieved from SSN776 to SSN782 (the third through ninth units). The build time was reduced from 86 to 63 months, and every submarine except the fourth was delivered ahead of schedule. These cost reductions were accomplished in parallel with new designs that improve performance, such as addition of a new payload module that will accommodate larger missiles and other payload concepts.

## Performance Based Logistics

The Should Cost approaches described thus far have been applicable to the investment phase of the life cycle. Recent studies have demonstrated that a Performance Based Logistics (PBL) contracting approach can yield demonstrated savings as well as improved performance outcomes in the Operations and Sustainment (O&S) phase (Boyce & Banghart, 2012). AH-64E Apache and the V-22 programs each realized significant cost savings through a PBL approach. According to the AH-64E PM, the PBL contract reduced spares in the pipeline and the amount of money required for the Working Capital Fund, resulting in savings of $276 million compared to the AH-64E POM estimate of the amount spent over the same time frame, based on its previous logistics approach. Likewise, the V-22 implemented a comprehensive O&S cost and performance improvement program that reduced costs-per-flying-hour from 2010–2012 by 18 percent, while improving the mission-capable rate from 53 to 68 percent. In addition to implementing PBL contracts with its prime and engine manufacturer, the V-22 did a wholesale review of its O&S costs that reclassified 414 parts from consumable to reparable, established industry support for depot standup, technical assistance and field training, and implemented an executive-level government/contractor review of O&S requirements and strategy.

**FIGURE 6. SCHEDULE REDUCTIONS ACHIEVED BY THE VIRGINIA-CLASS SUBMARINE PROGRAM**



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## Creating a Competitive Environment

In discussing the best way to achieve desired performance at acceptable cost, many leaders stress the importance of creating a competitive environment. At DAU's 2011 Program Executive Officer/Systems Command (PEO/SYSCOM) Commanders' Conference, several SAEs expressed the view that where healthy competition exists, the resulting award is in essence a Should Cost target for the contract. Several programs in this study adopted program-specific approaches that maximized or leveraged competition to obtain advantageous prices that were below the government's Will Cost and/or POM position. Three such programs were the DDG-51, which maximized competition in its dual award to two technically qualified bidders through a Profit-Related-to-Offer (PRO) contracting strategy (Vandroff & Kimble, 2013); KC-46, which altered its Best Value competitive strategy between 2008 and 2011 to place a premium on price; and Littoral Combat Ship (LCS), which altered its competitive strategy from downselect to multiple awards based on affordable proposals received as a result of a robust competitive environment.

## Closing Thoughts

The approaches described herein are just a few of many possibilities to reduce costs and improve efficiency through Should Cost management. Experienced acquisition professionals will recognize that most of the approaches described are not new, but require an abundance of strategic thinking and planning, and a long-term vision. Significant fiscal constraints are now reality, so Should Cost management is less viewed as a way for "someone to cut my program's budget," than a tool to protect a program from inevitable budget cuts. The philosophy expressed by Under Secretary of Defense for Acquisition, Technology and Logistics Frank Kendall, the current USD(AT&L), has consistently been that Should Cost is a way for programs to "beat the budget," so programs spend less than their ICE. That change alone would make an enormous difference in DoD's credibility with Congress and the American people, ending the DoD's long-standing pattern of emphasizing performance and capability above all, and accepting cost and schedule growth as inevitable.

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## Author Biography

**Dr. Mark Husband** is the senior advisor for Root Cause Analyses, Office of Performance Assessments and Root Cause Analyses, USD(AT&L), OSD. Dr. Husband is responsible for root cause analyses of programs that have incurred a Nunn-McCurdy breach, and others as assigned by USD(AT&L). He conducted the study described herein while assigned to Defense Acquisition University as a professor of Cost Analysis and Systems Engineering. Dr. Husband is a retired Air Force officer with a PhD in Chemical Engineering from the University of Karlsuhe.

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## Endnotes

1
1. Scrutinize every element of program cost.
2. Look for savings in repetitive activities.
3. Leverage learning curves.
4. Examine overhead and indirect costs.
5. Incentivize your contractor on cost savings.

2
1. Scrutinize each contributing ingredient of program cost and justify it. Why is it as reported or negotiated? What reasonable measures might reduce it?
2. Particularly challenge the basis for indirect costs in contractor proposals.
3. Track recent program cost, schedule and performance trends, and identify ways to reverse negative trend(s).
4. Benchmark against similar DoD programs and commercial analogues (where possible), and against other programs performed by the same contractor or in the same facilities.
5. Promote Supply Chain Management to encourage competition and incentivize cost performance at lower tiers.
6. Promote.
7. Identify opportunities to break out Government-Furnished Equipment versus prime contractor-provided items.
8. Identify items or services contracted through a second- or third-party vehicle. Eliminate unnecessary pass-through costs by considering other contracting options.
9. In the area of test:
   a. Take full advantage of integrated Developmental and Operational Testing to reduce overall cost of testing; and
   b. Integrate modeling and simulation into the test construct to reduce overal1 costs and ensure optimal use of national test facilities and ranges.
10. Identify an alternative technology/material that can potentially reduce development or life-cycle costs for a program. Ensure the prime product contract includes the development of this technology/material at the right time.

3 The first is through a bottoms-up estimate…The second method is to identify reductions from "Will-Cost" estimates…A third method, where applicable, should use competitive contracting and contract negotiations to identify Should-Cost savings.

4 https://acc.dau.mil/april13htf — URL for video and presentation slides from DAU's Better Buying Power Hot Topics Forum presentation held on April 9, 2013.

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# APPENDIX

## List of Abbreviations and Acronyms

**ACAT** . . . . . . . . . . . .Acquisition Category
**Acq**. . . . . . . . . . . . . . . . . . . . . . . Acquisition
**AIM**. . . . . . . . . . . . . . . Air Intercept Missile
**AOTD**. . .Active Optical Target Detector
**AOTD-STE/TE** . . Active Optical Target Detector-Special Test Equipment/Test and Evaluation
**AOTR**. . . . . . Assessment of Operational Test Readiness
**ASA/ALT** . . . Assistant Secretary of the Army for Acquisition, Logistics and Technology
**ATEC** . . . . . . . . . . . . . .U.S. Army Test and Evaluation Command
**AUR** . . . . . . . . . . . . . . . . . . . . All Up Round
**BBP** . . . . . . . . . . . . .Better Buying Power
**B-LRIP**. . . . . . . . Beyond-Low Rate Initial Production
**CA**. . . . . . . . . . . . . . . . . . . .Contract Award
**CAP** . . . Combined Aggregate Program
**CAPE** . . Cost Assessment and Program Evaluation
**CAS** . . . . . . . . Control Actuation Section
**CATM**. . . . . . Captive Air Training Missile
**CATM BIT**. . . . . . . . . Captive Air Training Missile Built-In Test
**CCB** . . . . . .Configuration Control Board
**CDR** . . . . . . . . . . . . . . . . . . . . .Commander
**CDRL** . . . . . . . . . . . Contract Deliverables Requirements List
**CLS**. . . . . . Contractor Logistics Support
**COTS/GOTS**. . . . . Commercial-Off-The-Shelf/Government Off-the-Shelf
**CPI** . . . . . . . . . . . . . . .Continuous Process Improvement
**CRTC** . . . . .Cold Regions Testing Center
**DAE** . . . . Defense Acquisition Executive
**DAU** . . . .Defense Acquisition University
**DDG** . . . . . . . . . Guided Missile Destroyer
**Demo**. . . . . . . . . . . . . . . . . Demonstration
**Dev**. . . . . . . . . . . . . . . . . . . . . .Development
**DoD** . . . . . . . . . . Department of Defense
**DT/OT** . . . . . . . .Developmental Testing/ Operational Testing
**ECS**. . . Electronic Concealment System
**EELV** . . . . .Evolved Expendable Launch Vehicle
**ELCAN AOTD** . . . . . . . . . ELCAN Optical Technologies (Division of Raytheon Company)
**EMD** . . . . . . Engineering, Manufacturing and Development
**ERB** . . . . . . . Engineering Review Board
**EU**. . . . . . . . . . . . . . . . . . . European Union
**FACO** . . .Final Assembly and Check Out
**FAR** . . . Federal Acquisition Regulation
**FCA** . . . Functional Configuration Audit
**Flts** . . . . . . . . . . . . . . . . . . . . . . . . . . Flights
**FMS** . . . . . . . . . . . . Foreign Military Sales
**FPIF** . . . . . . . . . . . . . Fixed Price Incentive (Firm Target)
**FRP**. . . . . . . . . . . . . . Full Rate Production
**FY**. . . . . . . . . . . . . . . . . . . . . . . . Fiscal Year
**GFX** . . . . . . . . . . . .Government Furnished Equipment
**GMLRS**. . . . . . . . Guided Multiple Launch Rocket System
**Gov.** . . . . . . . . . . . . . . . . . . . . . .Government
**GPS** . . . . . . . . .Global Positioning System
**GSIL** . . . . . . . . . . . . . . . . Ground Segment Integration Lab
**HUMINT** . . . . . . . . . . Human Intelligence
**HW** . . . . . . . . . . . . . . . . . . . . . . . . Hardware
**HW ECP** . . . . . . . Hardward Engineering Change Proposal
**IAMD** . . . . . . . .Integrated Air and Missile Defense
**IBCS COMMS**. . . . Integrated Battlefield Control System, Communications Management System

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**ICE** . . . . . . . . Independent Cost Estimate
**IDR** . . . . . . . . . . . . Interim Design Review
**IFC** . . . . . . . . . . . . Integrated Fire Control
**IFCN** . . Integrated Fire Control Network
**IMU** . . . . . . . . . . Inertial Measurment Unit
**IOC** . . . . . . . Initial Operational Capability
**IOT** . . . . . . . . . Initial Operational Testing
**IRST** . . . . . . . . Infrared Search and Track
**LCS** . . . . . . . . . . . . . . Littoral Combat Ship
**LOG** . . . . . . . . . . . . . . . . . . . . . . . . Logistics
**LRIP** . . . . . . . Low Rate Initial Production
**LRIP-I** . . . . . . . . . . . . . . . . . . . . . LRIP Lot 1
**Maint** . . . . . . . . . . . . . . . . . . . . Maintenance
**MDAP** . . . . . . . Major Defense Acquisition Program
**M&S** . . . . . . . . . Modeling and Simulation
**MIP** . . . . . . . . . . . . . . . . Material in Process
**MOS** . . . . . . . . . . . . . Mean Opinion Score
**MR** . . . . . . . . . . Manufacturing Readiness
**MRA** . . . . . . . . . Manufacturing Readiness Assessment
**MRL** . . . Manufacturing Readiness Level
**MS** . . . . . . . . . . . . . . . . . . . . . . . . . Milestone
**MYP** . . . . . . . . . . . Multiyear Procurement
**NCOC** . . . . . . . . Nano-Composite Optical Ceramics
**NIPR** . . Non-Classified Internet Protocol
**NGSB . . . . . . . . . . .** Northrup Grumman Shipbuilding
**nLight** . . . . . . . . . . . . nLight Corporation (Vancouver, WA)
**NSP** . . . . . . . . . . . . Not Separately Priced
**O&S** . . . . . . Operations and Sustainment
**OEM** . . . . . . . . . . . . . . Original Equipment Manufacturer
**OER** . . . . . . . . . Operational Test Agency Evaluation Report
**OMAR** . . . . . . . Operational Test Agency Milestone Assessment Report
**OSD** . . . . . . . . . . . Office of the Secretary of Defense
**P&F** . . . . . . . . . . . . . . . . . . . . Plug and Fight
**PBL** . . . . . . Performance Based Logistics
**PCA** . . . . . . Physical Configuration Audit
**PEO/SYSCOM** . . . . . . Program Executive Officer/Systems Command
**PHC** . . . . . . . . . . . Pressure Hull Complete
**PM** . . . . . . . . . . . . . . . . . . Program Manager
**PMO** . . . . . Program Management Office
**POA&M** . . . . . . . . . . . . Plan of Action and Milestones
**POM** . Program Objective Memorandum
**POP** . . . . . . . . . . . Period of Performance
**PRO** . . . . . . . . . . . Profit-Related-to-Offer
**PRR** . . . Performance Readiness Review
**Qual** . . . . . . . . . . . . . . . . . . . . . . . . . Quality
**Rpt** . . . . . . . . . . . . . . . . . . . . . . . . . . Report
**RTOC** . . . . Reduction in Total Ownership Cost
**SAE** . . . . . . Service Acquisition Executive
**SBR** . . . . . . . . . . . System Baseline Review
**SEPM** . . . . . . . . Systems Engineering and Program Management
**SI** . . . . . . . . . . . . . . . . . Systems Integration
**SNAP** . . . . Simplified Nonstandard Item Acquisition Program
**SP** . . . . . . . . . . . . . . . . . . . . . . . . Start Pulse
**Spec** . . . . . . . . . . . . . . . . . . . . Specification
**SRR** . . . . . . . Software Readiness Review
**TCM** . . . TRADOC Capabilities Manager
**TC-S** . . . . . Trajectory Correction System
**TDP** . . . Technology Development Phase
**TRADOC** . . . . . . . . . . . U.S. Army Training nd Doctrine Command
**USD(AT&L) . . . . . . .** Under Secretary of Defense (Acquisition, Technology and Logistics)
**USG** . . . . . . . . United States Government


FURLOUGHS

**Keywords:** *Furlough, Work Rate Analysis, Productivity, Cost Reduction, Acquisition Systems*

# *Adverse Impacts of Furlough Programs on Employee Work Rate and Organizational Productivity*

*Adedeji Badiru*

This article is primarily a research-provoking exposition against the management approach used in the 2013 government furlough program. It is intended to prompt potentially productive research investigations on the impact of personnel furloughs, particularly on defense acquisition programs. Defense acquisition programs are time-sensitive and systems-oriented. What appears as a minor delay in one unit of an acquisition life cycle can lead to long-term encumbrances within the entire defense system, resulting in enormous cost escalation. Pertinent analytical techniques/methodologies are provided to illustrate potential pathways for further research studies of furloughs and how they adversely impact organizational productivity. The author's intent is to provoke research so that future furloughs can be better conceived, planned, executed, and managed—or avoided altogether.

*« Image designed by Diane Fleischer*

High-dollar acquisition programs that suffer productivity impediments can lead to enormous cost escalations. A case example (Carey, 2012) is the 2012 revelation by the U.S. Government Accountability Office (GAO) that the U.S. Air Force would spend $9.7 billion over 20 years to upgrade the capabilities of the F-22A Raptor as a result of the failure to anticipate the plane's long-term need for technology modernization. In high-cost and time-sensitive programs such as the F-22A Raptor, any additional slowdown and work rate decline in the acquisition process can result in adverse impacts on the overall readiness of the nation. Workforce work rate has a direct impact on overall organizational productivity. The very premise of the defense acquisition program is to ensure timely acquisition and deployment of critical technology to aid the warfighter. The purpose of this article is to provide thought-provoking research methodologies to analyze the management of furlough programs with respect to work productivity. Furlough-induced work slowdown in one segment of a defense organization can lead to overall work rate decline, with a resultant decline in overall productivity and cost escalation. A furlough program takes both leadership and employees away from productive work because planning spans multiple weeks. Although the hypothesis of the article is anecdotal, it does present the basis for further empirical studies. This article is intended to provoke more data-driven research on employee work rate analysis. Because 100 percent of the work cannot be done by fewer human resources working at the normal work rate during a furlough, a research study is needed to guide future decisions.

## Impacts of Furlough Programs on Acquisition Systems

Program delays are triggered by many possible sources, including those caused by a lack of cohesive budget agreement and political discord, which result in the need for furloughs. Three leading sources of delays in acquisition programs are

- technological limitations, such as a sluggish maturation of new technology;
- externally imposed limitations, such as the prevailing global economic developments; and

- self-induced procedural limitations, such as political discord or procedural inefficiency.

The ongoing federal budget sequestration is wreaking havoc on organizational productivity throughout the Department of Defense (DoD). An August 1, 2013, news headline read, “New Air Force center to lose 1.3M hours to sequester” (Barber, 2013). The news went on to affirm how the mid-year sequestration budget cuts are adversely affecting the Air Force Life Cycle Management Center (LCMC). A productivity loss of 1.03 million hours, depending on the base wage rate used, can translate to as much as $70 million. Taking into consideration the 600,000-plus employees across DoD during a furlough program, 100 percent of the work obviously cannot be fulfilled by the furlough-depleted workforce working at the original work rate. The economic impact of the reduction of work output is a good topic for future research. For a sequestration program that is purportedly saving money, losing that much money is a move in the wrong direction. In addition to the serious financial impacts of furlough programs on family take-home disposable incomes, social well-being and community economic performance also suffer grave consequences. Those personal impacts, coupled with organizational loss of productivity, make the net cost savings of furlough programs negligible.

## Logistics and Acquisition Disaggregation

Stone (2013) emphasizes how the civilian furlough period caused delays in moving and maintaining equipment at a time that the military cannot afford any operational disruption. The wartime drawdown is just one piece of the jigsaw complexity of military logistics and acquisition. A poorly executed furlough program complicates an already complex undertaking. People and equipment have to be moved under a tight schedule with a shrinking base budget.

The civilian workforce provides a key linkage between everything that has to be done. Reducing the availability of the workforce through a furlough program at a critical time impedes the overall goal of the DoD. To reiterate, 100 percent of the work cannot be done by a reduced workforce working at the original work rate.

## Furloughs and Loss of Productivity

Employee furloughs, as a mechanism to achieve federal budget savings, do have deleterious effects on employee morale, functional coordination, and employee work rates. When morale is low, all other

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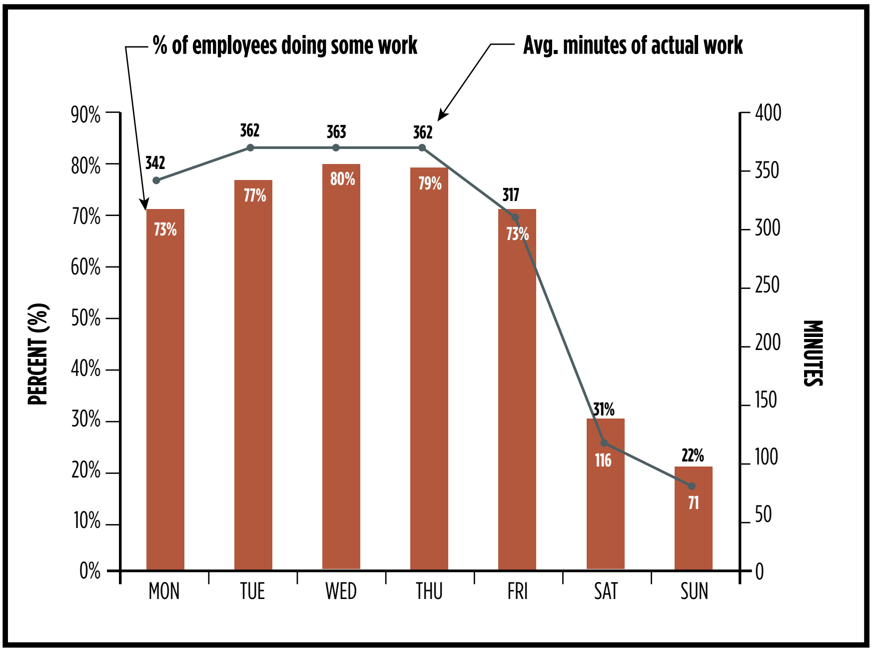
factors of productivity are adversely impacted. Thus, furloughs have several unintended consequences. In essence, employee furloughs do not offer much in the way of long-term benefits. Work backlogs that are caused by furloughs subsequently take months to complete. To protect personnel-related data, hypothetical values are used in the computational examples. Organizations wishing to implement the computational methodologies presented in this article will use their own unit-specific data values. One anticipated benefit of the article is that it will open up avenues for discussions and more rational decisions in advance of any future furlough programs. Ideally, any future furlough programs can be better conceived, planned, executed, and managed—or avoided altogether. In the author's own furlough experience, the 2013 DoD furlough program created protracted planning, execution ambiguity, disjointed implementations, uncertainty of expectations, inconsistent guidance, and disruption of workflow processes. The resultant adverse impacts degraded overall organizational productivity and impeded national defense preparedness.

For the specific case at Wright-Patterson Air Force Base, the furlough period began the week of July 8, 2013, for about 10,000 civilians. In the initial DoD implementation, civilians who were affected by the furlough were expected to endure a scheduled unpaid day off each week for a total of 11 furlough days. Although this was later cut down to six furlough days, the productivity damage had already been done. Considering that the same amount of work had to be accomplished, furloughed employees were expected to prioritize tasks to determine what gets done and what gets compromised.

In the absence of a standardized process, employees may inadvertently marginalize high-value tasks. Even flexibility for an employee to choose which day of the week to take a furlough has some unanticipated adverse impacts. In a normal workweek devoid of furlough or sequestration distractions, Monday is typically the busiest (but not necessarily the most productive) day of the week. Tuesday is seen as the most productive day while Friday is the least busy day and, potentially, least productive. This phenomenon is a human cultural reaction to the progression of a workweek that has been confirmed by several labor research studies (Dawkins & Tulsi, 1990; Pettengill, 1993; Weiss, 1996; Hill, 2000; Pettengill, 2003; Campolieti & Hyatt, 2006; Chandra, 2006; Taylor, 2006; Bryson & Forth, 2007a; Bryson & Forth, 2007b; Golden, 2011). One adverse impact of variable furlough days is the difficulty

**FIGURE 1. WORK-DAY-BASED RAMP-UP AND RAMP-DOWN OF WORKER PRODUCTIVITY**




*Note.* Adapted from, "Are There Day-of-the-Week Productivity Effects?" by A. Bryson & J. Forth, Centre for Economic Performance, The London School of Economics and Political Science, 2007a.

in synchronizing work across functional areas, which leads to overall diminished work output. Figure 1 illustrates a similar diminished work output based on a study by Bryson and Forth (2007a). While the data in the study do not represent DoD acquisition workforce of interest, the productivity ramp-up and ramp-down process is evident in every workforce; and the topic is fertile for future research.

According to a probability distribution law called the Pareto Distribution, and judging by normal human nature in 80 percent of the population, some less-motivated workers, if given the option of picking a furlough day, will pick Monday. Monday, being the busiest day, is the day to opt out of work. The research literature has confirmed that Monday experiences the highest level of sick-day call-ins (KRONOS®, 2004). Friday, a normally slow day, is perceived as a day to come to work, knowing that typically not much work stress will occur on that day. These two bipolar behavioral observations will, thus, have greater adverse impact on overall productivity than what a normal furlough day might be expected to produce. The normally busy Monday suffers in two ways: (a) reduced workforce due to furlough, and (b) critical work pushed further down the week due to elective furlough-day selection.

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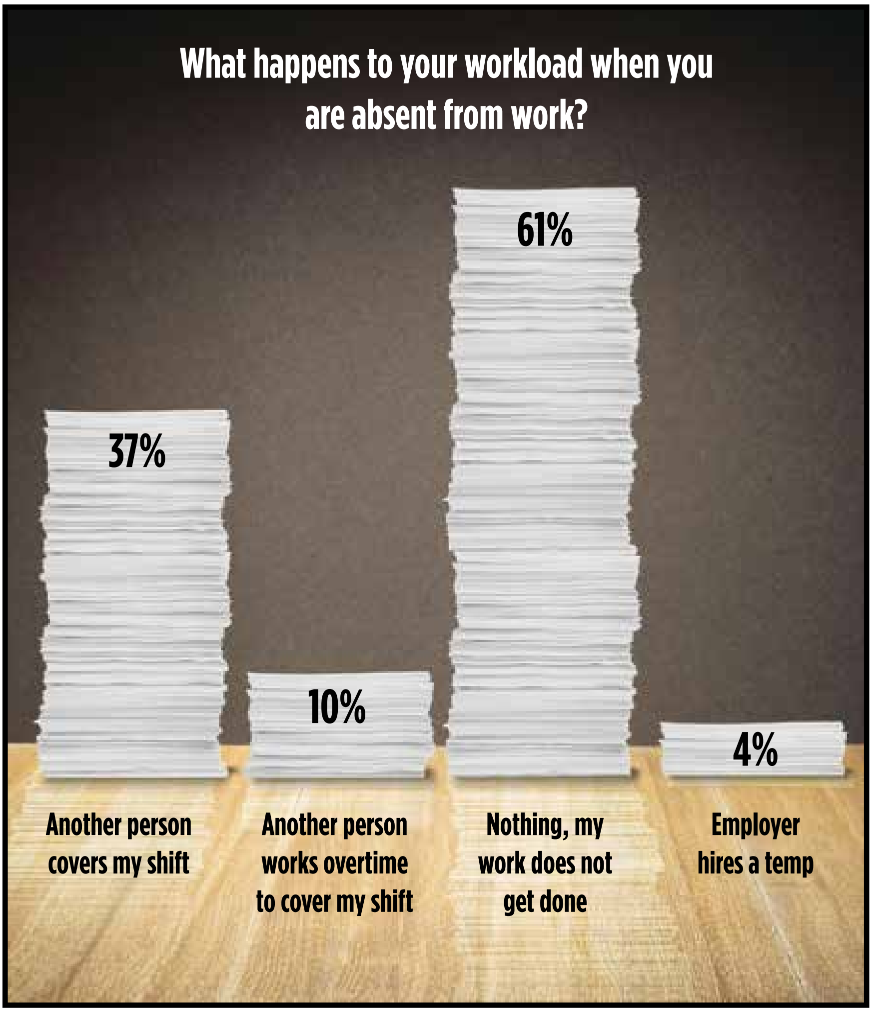
The situation can be compounded by some people taking Friday off one week, then taking Monday off the next week. Due to several subtle factors such as the above, getting two full workday equivalents out of Monday and Friday proves fallacious in actual practice. The following actual, but paraphrased statement typifies the type of negative work impacts that the uncoordinated furlough program and sequestration caused (personal communication with a co-worker, July 30, 2013). This statement is in response to a query following a critical task that went uncompleted and untracked for weeks:

I apologize for the delay. While waiting for a response, I put the request in a follow-up folder; since I am part-time, and we have taken on the responsibilities of laid-off employees, not to mention the day of work we lose due to the furlough, it has taken me this long to get a moment to follow up on the task. Please know that I do not intend to make excuses, but merely to explain the circumstances.

Figure 2, based on a 2004 survey conducted by Harris Interactive for KRONOS®, Inc., illustrates that 61 percent of respondents report that "nothing gets done on their workload when they are absent from work." The population surveyed was a general office workforce. While this is not a DoD workforce, similarities are noted in the office work environment of both populations.

Where human work is concerned, the psychology of work must be taken into account when deciding on new work practices either as a response to budgetary pressures or in pursuit of process improvement goals. The literature is replete with relevant research studies in this regard (Baltes, Briggs, Wright, & Neuman, 1999; Hamermesh, 1999; Bailey & Kurland, 2002; Askenazy, 2004; Berg, Appelbaum, Bailey, & Kalleberg, 2004; Bertschek & Kaiser, 2004; Böheim & Taylor, 2004; Heisz & LaRochelle-Côté, 2006; Altman & Golden, 2007; Kelliher & Anderson, 2010). Unfortunately, technical workforce teams, such as those in defense acquisition programs, are rarely studied with respect to the best way to manage work schedules. Therein lies a flaw in the across-the-board implementation of the present furlough program. Even the peer review process of this journal, *Defense ARJ,* is encumbered by the furlough program.

**FIGURE 2. ADVERSE IMPACT OF FURLOUGHS ON PRODUCTIVITY**




*Note.* Adapted from "Working in America: Absent Workforce," by KRONOS® Inc., 2004.

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## The Link between Productivity and Operational Cost

The U.S. Government is using the SAVE (Securing Americans Value and Efficiency) program to solicit ideas from all federal employees to help identify areas where the nation can "cut wasteful spending." A review of the SAVE award Web site at http://www.whitehouse.gov shows that 89,000 ideas have been submitted over the past 4 years since the program started in 2009. It should be noted, however, that any cut of "wasteful spending" should be coupled with a mitigation of the subtle avenues of eroding productivity. Blake (2011) reports that improving functional productivity can translate to lower operating cost. "Industrial engineers make systems function better together with less waste, better quality, and fewer resources."

As with every organization, a major goal of the U.S. Air Force is to eliminate waste, in consonance with the federal goal of cutting wasteful spending. In spite of its goal, some cost-cutting programs instead have the unintended consequence of reducing productivity, which increases operating costs. Consequently, the savings from cutting wasteful spending are nullified by the higher cost of lower productivity. An uncoordinated implementation of furlough programs is one glaring example of "robbing Peter to pay Paul." Efficiency, effectiveness, productivity, and cost reduction must be integrated analytically to get the desired composite organizational benefits. Organizational performance is defined in terms of several organization-specific metrics, which include efficiency, effectiveness, and productivity. The existing techniques for improving efficiency, effectiveness, and productivity (Badiru & Thomas, 2013, and all the references therein) are suitable for analyzing the impacts of furloughs. Efficiency refers to the extent to which a resource (time, money, effort, etc.) is properly utilized to achieve an expected outcome. The goal, thus, is to minimize resource expenditure, reduce waste, eliminate unnecessary effort, and maximize output. The ideal (i.e., the perfect case) is to have 100 percent efficiency. This is rarely possible in practice. Usually expressed as a percentage, efficiency (*e*) is computed as output over input:

$$e = \frac{output}{input} = \frac{\text{result}}{\text{effort}}.$$

The above ratio is also adapted for measuring productivity (Badiru & Thomas, 2013).

Effectiveness is primarily concerned with achieving the specific objectives, which constitute the broad goals of an organization. To model effectiveness quantitatively, we can consider the fact that an "objective" is essentially an "output" related to the numerator of the efficiency equation above. Thus, we can assess the extent to which the various objectives of an organization are met with respect to the available resources. Although efficiency and effectiveness often go hand-in-hand, they are, indeed, different and distinct. For example, one can forego efficiency for the sake of getting a particular objective accomplished. Consider the statement, "if we can get it done, money is no object." The military, by virtue of being mission-driven, often operates this way. If, for instance, our goal is to go from point A to point B to hit a target—and we do hit the target, no matter what it takes—then we are effective. We may not be efficient based on the amount of resources expended to hit the target. A cost-based measure of effectiveness is defined as:

$$ef = \frac{s_o}{c_o}, \quad c_o > 0$$

Where:

$ef$ = measure of effectiveness on interval (0, 1)

$s_o$ = level of satisfaction of the objective (rated on a scale of 0 to 1)

$c_o$ = cost of achieving the objective (expressed in pertinent cost basis: money, time, measurable resource, etc.)

If an objective is fully achieved, its satisfaction rating will be 1. If not achieved at all, it will be zero. Thus, having the cost in the denominator gives a measure of achieving the objective per unit cost. If the effectiveness measures of achieving several objectives are to be compared, then the denominator (i.e., cost) will need to be normalized to a uniform scale. The overall system effectiveness can be computed as the summation that follows:

$$ef_c = \sum_{i=1}^{n} \frac{s_o}{c_o}$$

Where:

$ef_c$ = composite effectiveness measure

$n$ = number of objectives in the effectiveness window

Depending on the units used, the effectiveness measure may be very small with respect to the magnitude of the cost denominator. This may be handled by converting the measure to a scale of 0 to 100. Thus, the highest comparative effectiveness per unit cost will be 100 while the lowest will be 0. The above quantitative measure of effectiveness makes most sense when comparing alternatives for achieving a specific objective. If the effectiveness of achieving an objective is desired in noncomparative absolute terms, it would be necessary to determine the range of costs, minimum to maximum, applicable for achieving the objective. Then, we can assess how well we satisfy the objective with the expenditure of the maximum cost versus the expenditure of the minimum cost. By analogy, "killing two birds with one stone" is efficient. By comparison, the question of effectiveness is whether we kill a bird with one stone or kill the same bird with two stones, if the primary goal is to kill the bird nonetheless. In technical terms, systems that are designed with parallel redundancy can be effective, but not necessarily efficient. In such cases, the goal is to be effective (get the job done) rather than to be efficient. Productivity is a measure of throughput per unit time. Typical productivity formulas include the following:

$$P = \frac{Q}{q}$$

$$P = \frac{Q}{q}(u)$$

where $P$ = Productivity; $Q$ = Output quantity; $q$ = Input quantity; and $u$ = Utilization percentage. Notice that $Q/q$ also represents efficiency (i.e., output/input) as defined earlier. Applying the utilization percentage to this ratio modifies the ratio to provide actual productivity yield. The acquisition workforce is composed primarily of knowledge workers, whose productivity must be measured in alternate terms, perhaps through work rate analysis, which is a focus in this article. Rifkin (2011) presents the following productivity equation suitable for implementation for the acquisition environment:

*Product* (i.e, output) = *Productivity* (objects per person-time) x *Effort* (person-time)

where *Effort* = *Duration* x *Number of People.*

While changes are essential for organizational improvement, they should be implemented in smaller manageable chunks, possibly incrementally, with respect to cost-cutting measures rather than one big furlough period. Organizational focus should be on gradual incremental improvement rather than one-fell-swoop drastic implementation of budget cuts. These two points need to be addressed in further detail via further research studies that are based on life data collection and analysis. The goal of this article is to provoke research by pointing out some basic examples of analytical computations.

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## Work Rate Computations

Work rate and work time availability are essential components of estimating the cost of specific tasks. Given a certain amount of work that must be done at a given work rate, the required time can be computed. Once the required time is known, the cost of the task can be computed on the basis of a specified cost-per-unit time. Work rate analysis is important for resource substitution decisions. The analysis can help identify where and when the same amount of work can be done with the same level of quality and within a reasonable time span by a less expensive resource. As a potential future research topic, learning curve analysis may be used to predict the expected work rate. Although not generally applicable across the board for government work, learning curves are still useful for cases where work output accountability is tracked. The general relationship among work, work rate, and time is given by:

work done = (work rate)(time)

$$w = rt$$

where:

$w$ = the amount of actual work done expressed in appropriate units. Examples of work units are number of contract reviews completed, lines of computer code typed, gallons of oil spill cleaned, units of a product produced, and surface area painted

$r$ = the rate at which the work is accomplished (i.e., work accomplished per unit time)

$t$ = the total time required to perform the work excluding any embedded idle times

For simplification, work is defined as a physical measure of accomplishment with a uniform density. For example, cleaning 1 gallon of oil spill may be as desirable as cleaning any other gallon of oil spill within the same work environment. The production of one unit of a product is identical to the production of any other unit of the product. If uniform work density cannot be assumed for the particular work being analyzed, weighting factors must be applied to the elements contained in the relationship. Uniformity can be enhanced if the scope of the analysis is limited to discrete work elements of similar design. The larger the scope of the analysis, the more the variability from one work unit to another, and the less uniform the overall work measurement will be. For example, in a project involving the construction of 50 miles of surface road, the work analysis may be done in increments of 10 miles at a time rather than the total 50 miles. If the total amount of work to be analyzed is defined as one whole unit, then the relationship below can be developed for the case of a single resource performing the work, with the parameters below:

| | |
|---|---|
| Work rate: | $r$ |
| Time: | $t$ |
| Work done: | 100 percent (1.0) |

The work rate, $r$, is the amount of work accomplished per unit time. For a single resource to perform the whole unit (100 percent) of the work, we must have the following:

$$rt = 1.0$$

For example, if an acquisition technician is to complete one work unit in 30 minutes, that technician must work at the rate of 1/30 of the work content per unit time. If the work rate is too low, then only a fraction of the required work will be performed. The information about the proportion of work completed may be useful for productivity measurement purposes. In the case of multiple technicians performing the work simultaneously, the work relationship is as presented in Table 1.

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**TABLE 1. WORK RATE TABULATION FOR MULTIPLE TECHNICIANS**

| Technician, $i$ | Work rate, $r_i$ | Time $t_i$ | Work done $w$ |
|---|---|---|---|
| Technician 1 | $r_1$ | $t_1$ | $(r_1)(t_1)$ |
| Technician 2 | $r_2$ | $t_2$ | $(r_2)(t_2)$ |
| ... | ... | ... | ... |
| Technician $n$ | $r_n$ | $t_n$ | $(r_n)(t_n)$ |
| | | **Total** | **1.0** |

Even though the multiple technicians may work at different rates, the sum of the work they all performed must equal the required whole unit. In general, for multiple resources we have the following relationship:

$$\sum_{i=1}^{n} r_i t_i = 1.0$$

where

$n$ = number of different resource types

$r_i$ = work rate of resource type $i$

$t_i$ = work time of resource type $i$

For partial completion of work, the relationship is

$$\sum_{i=1}^{n} r_i t_i = p$$

where $p$ is the proportion of the required work actually completed. In any furlough program, the expectation of 100 percent work completion does not match reality. Under a furlough program, only a fraction of the expected work will get done.

## Employee Work Rate Examples

Under a furlough program, there can be no expectation that 100 percent of the work can be accomplished with a 20 percent reduction of human resources operating at the prefurlough work rate. Suppose Technician A, working alone, can complete a task in 50 minutes. After working on the task for 10 minutes, Technician B is brought in to work with Technician A to complete the job. Both technicians, working together as a team, finish the remaining work in 15 minutes. We are interested in finding the work rate for Technician B if the amount of work to be done is 1.0 whole unit (i.e., 100 percent of the job). The work rate of Technician A is 1/50. The amount of work completed by Technician A in 10 minutes, working alone, is (1/50)(10) = 1/5 of the required total work. Therefore, the remaining amount of work to be done is 4/5 of the required total work. That is:

$$\frac{15}{50}+15\left(r_2\right)=\frac{4}{5}$$

which yields $r2$ = 1/30. Thus, the work rate for Technician B is 1/30. That means Technician B, working alone, can perform the same job in 30 minutes. A tabulated summary of this example is shown in Table 2.

**TABLE 2. WORK RATE TABULATION FOR TECHNICIANS A AND B**

| Technician, $i$ | Work rate, $r_i$ | Time $t_i$ | Work done $w$ |
|---|---|---|---|
| Technician A | 1/50 | 15 | 15/50 |
| Technician B | $r_2$ | 15 | 15($r_2$) |
| | | **Total** | **1.0** |

In this example, it is assumed that both technicians produce an identical quality of work. If quality levels are not identical, we must consider the potentials for quality-time trade-offs in performing the required work. The relative costs of the different technician skills needed to perform the required work may be incorporated into the analysis as shown in Table 3.

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**TABLE 3. INCORPORATION OF WAGE COST INTO WORK RATE ANALYSIS**

| Technician, $i$ | Work rate, $r_i$ | Time $t_i$ | Work done $w$ | Pay rate $p_i$ | Wage $P_i$ |
|---|---|---|---|---|---|
| A | $r_1$ | $t_1$ | $(r_1)(t_1)$ | $p_1$ | $P_1$ |
| B | $r_2$ | $t_2$ | $(r_2)(t_2)$ | $p_2$ | $P_2$ |
| ... | ... | ... | ... | ... | ... |
| $n$ | $r_n$ | $t_n$ | $(r_n)(t_n)$ | $p_n$ | $P_n$ |
| | | Total | 1.0 | | Budget |

Using the above relationship for work rate and cost, the work crew can be analyzed to determine the best strategy for accomplishing the required work, within the required time and within a specified budget, in a climate of a furlough program. For another simple example of possible acquisition scenarios, consider a case where an acquisition information technology (IT) technician can install new IT software at three work stations every 4 hours. At this known rate, it becomes possible to compute how long it would take the technician to install the same software at five work stations. The proportion that "three stations" is to 4 hours is equivalent to the proportion that "five stations" is to $x$ hours, where $x$ represents the number of hours the technician would take to install software in the five stations. This gives the following work-and-time ratio relationship:

$$\frac{3 \text{ work stations}}{4 \text{ hours}} = \frac{5 \text{ work stations}}{x \text{ hours}},$$

which yields $x = 6$ hours, 40 minutes. Now consider a situation where the technician's competence with the software installation degrades over time for whatever reason, possibly due to furlough interruptions. We will see that the time requirements for the IT software installation will vary depending on the current competency level and the availability of the technician. Consider another example where an acquisition analyst can do contract checks at the rate of 120 contract line items per minute. A supervisor can inspect the checkmarks at the rate of three per second. How many supervisors are needed to keep up with 18 acquisition analysts? At the work rate given, one analyst can complete the task at the rate of two per second (i.e., 120 checkmarks every 60 seconds). So, 18 analysts would complete 36 checkmarks per second. Now let $x$ be the number of supervisors needed to keep up with the 18 analysts. Since one supervisor completes three inspections per second, $x$ supervisors would inspect $3x$ checkmarks per second. That is, $3x = 36$, which yields $x = 12$ supervisors. Overall work slowdown will occur if, due to furloughs, the supervisors needed are not available to keep up with the workload. By the author's own estimation in his direct furlough experience, as much as 25 percent of required work process checkmarks may be missed.

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Another illustrative example: Suppose that because of Team Member 1's work rate, a certain task can be performed in 30 days. The addition of Team Member 2 to the task is desirable so that the completion time of the task can be reduced. The work rate of Team Member 2 is such that the same task can be performed alone in 22 days. If Team Member 1 has already worked 12 days on the task before Team Member 2 joins the effort, we want to find the completion time of the task if Team Member 1 starts the task at time 0. The amount of work to be done is 1.0 whole unit (i.e., the full task). The work rate of Team Member 1 is 1/30 of the task per unit time. The work rate of Team Member 2 is 1/22 of the task per unit time. The amount of work completed by Team Member 1 in the 12 days, working alone, is (1/30)(12) = 2/5 (or 40 percent) of the required work. Therefore, the remaining work to be done is 3/5 (or 60 percent) of the full task. If we let $T$ be the time for which both members work together, then we will have the following work-and-time equation:

$$T/30 + T/22 = 3/5$$

which yields $T = 7.62$ days. Thus, the completion time of the task is $(12 + T) = 19.62$ days from time zero. It is assumed that both members produce identical quality of work and that the respective work rates remain consistent. The respective costs of the different resource types may be incorporated into the work rate analysis to determine where real cost savings can be achieved.

## Furlough-Induced Work Rate and Productivity

The key benefit of doing an analytical work rate analysis is that the disconnection between employee work and the prevailing workload can be brought to the forefront. As a case example, the 2013 implementation of furlough days at Wright-Patterson Air Force Base required each eligible employee to go on furlough 1 day each workweek for 11 weeks, which was later reduced to 6 weeks. For each week, this represented a

20 percent loss of availability to work. Meanwhile, the workload was not adjusted downward to account for the 20 percent loss of employee time availability. This resulted in an effort to do the same workload (even more, in some cases) with less employee time. A simple Pareto plot of this work scenario quickly reveals a serious disconnect. To balance the equation, either the work rate of employees will have to increase or the expected work output (i.e., requirements) will need to be reduced. Figure 3 shows a pictorial representation of this disconnection.

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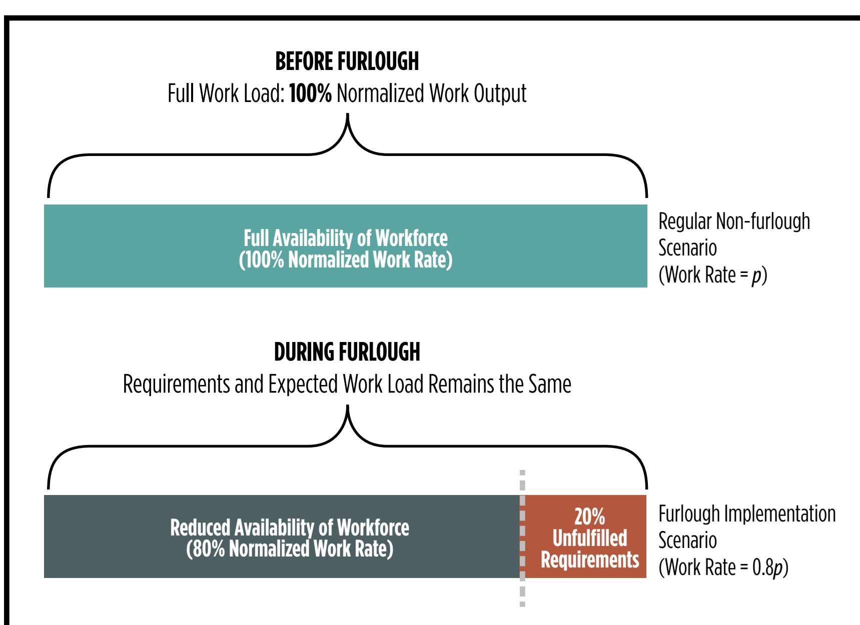
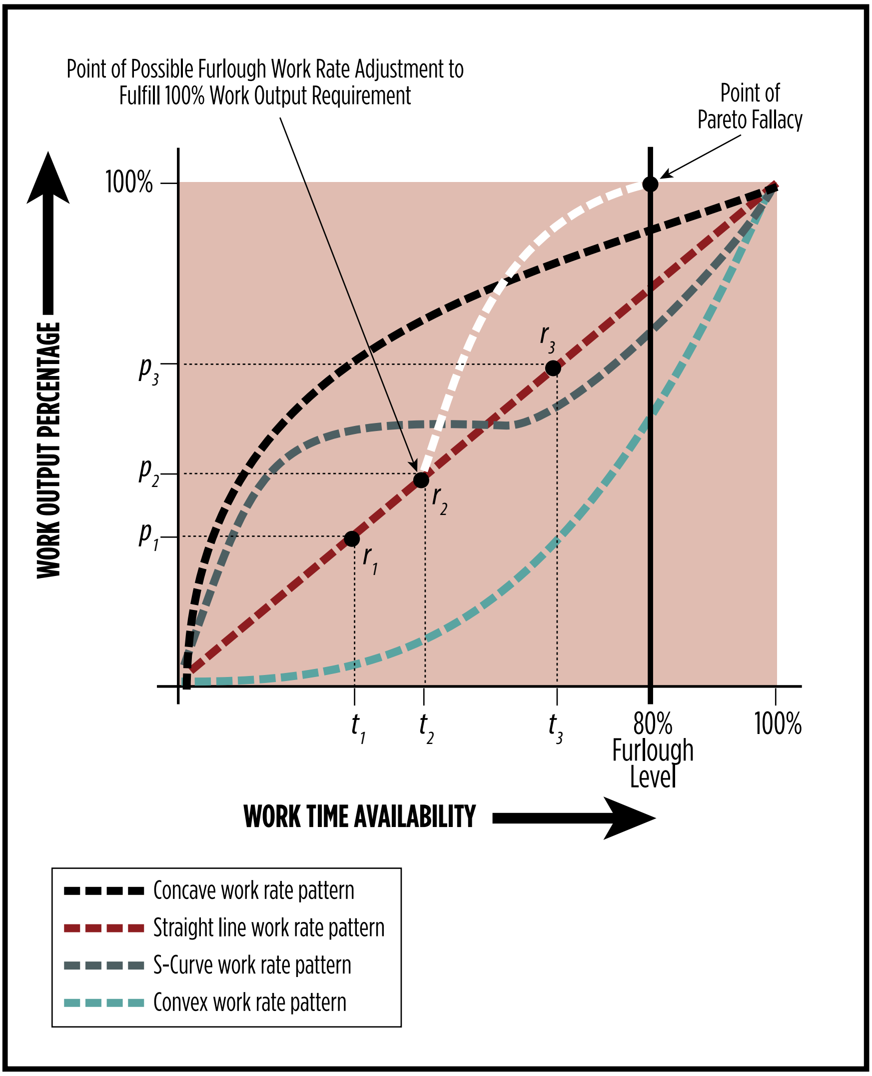
Figure 4 presents examples of furlough work rate adjustment curves. The black curve represents a concave path for 100 percent completion of the workload at 100 percent employee work time availability. The red curve follows a straight-line path for work completion at 100 percent-for-100 percent work rate. The green curve follows an S-curve for completing the full workload. The blue curve represents a convex path for executing the 100 percent workload at 100 percent employee time availability. If employee time availability is cut to 80 percent (i.e., one workday furlough per workweek) as in the DoD furlough implementation, employee work rates must be adjusted upward if the expected workload

**FIGURE 3. PARETO ANALYSIS OF FURLOUGH WORK RATE VERSUS REQUIREMENTS WORK LOAD**



is still to be accomplished. This is represented by the white curve starting at the point $r_2$ and ending at the intersection of 100 percent workload and 80 percent work time availability. The $r_2$ point was selected because it offers a mid-range point on the curve. In other words, we still accomplish most (if not all) of the required work using only 80 percent work time availability. But this is at the expense of a higher midstream work rate of the employee. Something will have to be compromised if we are

**FIGURE 4. FURLOUGH WORK RATE ADJUSTMENT CURVES**



expecting the same work output from the same standard work rate under a reduction in work time availability. It should be pointed out, though, that the presumption of 100 percent completion of government work is not realistic. The concept may work analytically for countable units of production, but not directly for office-type work outputs. The concept, nonetheless, does provide guidance for rational thought about managing office work output under the condition of a furlough program.

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We can now apply the above analysis to the previous example of team work rate analysis. If work rates remain the same, we must either reduce the work content or increase the duration (number of days) over which the task is accomplished. If the task duration is to be kept the same at $D$ = 19.62 days, then work rates must the adjusted. Let us assume the following notations:

$x_1$ = Normal work rate of Team Member 1

$x_{1(f)}$ = Furlough work rate of Team Member 1

$x_2$ = Normal work rate of Team Member 2

$x_{2(f)}$ = Furlough work rate of Team Member 2

$D$ = Fixed expected task duration in days = 19.62 days

T = Number of days remaining to due date = 19.62 days – 12 days = 7.62 days

Normally, Team Member 1 can complete the task in 30 days at a work rate of 1/30. So, $x_1$ = 1/30. From the data given previously, $x_2$ = 1/22. Team Member 1 works for 12 days before handing over to Team Member 2. Assuming that the work rate of Team Member 2 is the one to be adjusted while keeping $r_{1(normal)}$ constant, we see that Team Member 1 completes 1/30 work-unit-per-day times 12 days, which yields 2/5 of the work content completed by Team Member 1 working alone. This leaves 3/5 of the work to be completed by Member 2. This gives us the relationship equation below:

$$T(x_1) + T(x_{2(f)}) = \text{Work Content Remaining To Be Done}$$

That is:

$$7.62(1/30) + 7.62(x_{2(f)}) = 3/5$$

But Member 1 hands over to Member 2 due to going on furlough. So, the above equation reduces to Member 2 working alone to complete the remaining 60 percent portion of the task in the 7.62 days before the due date. That is:

$$7.62(x_{2(f)}) = 3/5$$

which yields $x_{2(f)} = 0.07874$ work content per day. This is considerably higher than the normal work rate of 1/22 (i.e., 0.04545) for Member 2. In fact, it is 173.25 percent of the normal work rate for Member 2, which is not practical to accomplish.

## Better Management of Furlough Programs

The Department of Defense is made of teams of military personnel, government civilians, and contractors, who are all expected to work together seamlessly. Any furlough program that targets only one segment of the collaborative teams will create long-lasting disruptions that will nullify the intended benefits of defense teams. While one group is on furlough, the nonfurlough groups cannot work at the best level of their potential. A prior analytical view of military-civilian work rate integration can help determine a better way to manage or avoid furloughs. Based on the analytical template presented above, the author recommends that future furlough programs, if there must be any, be managed with a consideration of the systems impact of employee absences. Systems engineering tools, such as the V-model (Defense Acquisition University, n.d.) and DEJI-model (Badiru, 2012) can be explored during the initial stages of furlough deliberations to determine how decision factors intermingled with respect to considerations for people, technology, and work processes. Figure 5 illustrates some of the factors of consideration in applying the DEJI-model.

**FIGURE 5. FURLOUGH PROGRAM DESIGN, EVALUATION, JUSTIFICATION, AND INTEGRATION**

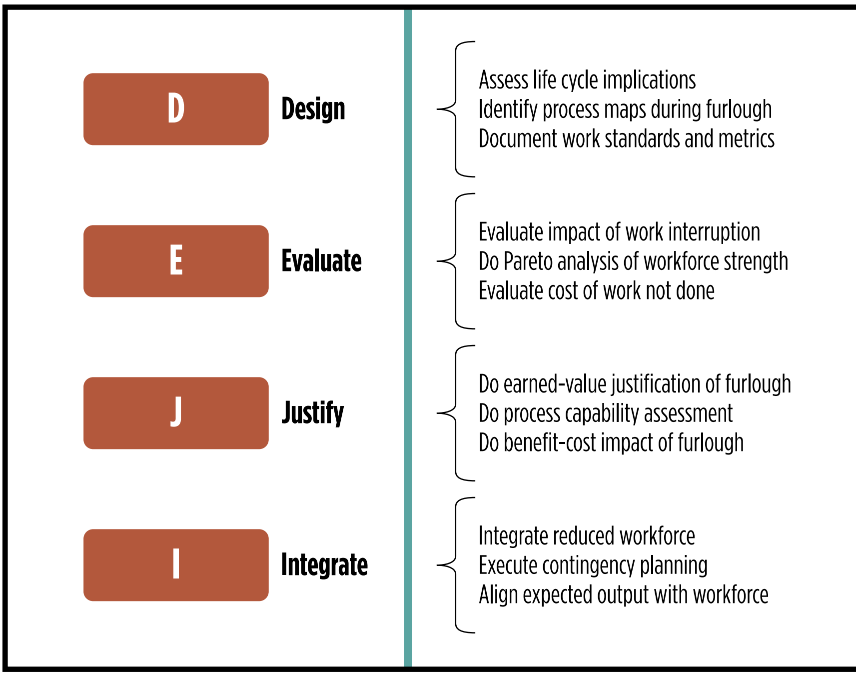
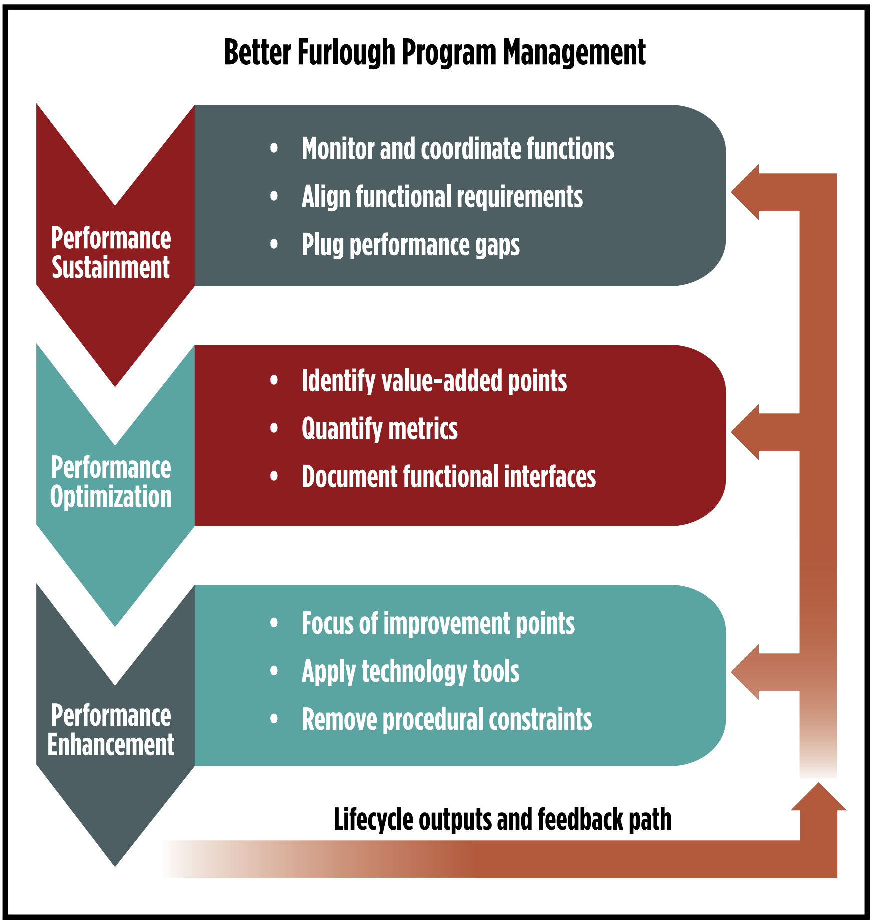



Figure 6 presents a flowchart of performance sustainment, leading to possible performance optimization and resulting in performance enhancement. Once performance enhancement is achieved, it would be fed back as a sustainment goal for monitoring and coordinating functions. In such a flow process, the potential adverse impact of a furlough program can be identified earlier and in advance.

## Implementation Strategy

The simple process of communication, cooperation, and coordination can be used to get everyone on board for a furlough program. Projects are executed and accomplished through the collective efforts of people, tools, and processes. Communication is the glue that binds all these together. The author's own observations indicate that most project failures can be traced to poor communication at the beginning. Even in highly machined/controlled processes, the occasional human intervention can spell doom for a project if proper communication is not in effect. We often erroneously jump to the coordination phase of a project, believing that this is where project execution lies. But the fact is that a

**FIGURE 6. LIFE-CYCLE FEEDBACK MODEL FOR BETTER FURLOUGH PROGRAM MANAGEMENT**




more fundamental foundation for project success lies well before the coordination phase. The author advocates building a structural project execution hierarchy, starting with Communication, which facilitates Cooperation, which paves the way for Coordination, and ending with the desired project success. That is, every project should build a project flow process as shown below:

Communication → Cooperation → Coordination → Program Success

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In the above process, investing in people communication is the easiest thing that an organization can do. Regardless of whatever technological tools, technical expertise, and enhanced processes are available in the project environment, basic human communication is required to get a project started right and moving forward efficiently and effectively. Communication highlights what must be done and when. It can also help to identify the resources (personnel, equipment, facilities, etc.) required for each effort. It points out important questions such as:

- Does each project participant know what the objective is?
- Does each participant know his or her role in achieving the objective?
- What obstacles may prevent a participant from playing his or her role effectively?
- Does each person have "buy-in" into the project?

Communication can mitigate disparity between concept and practice because it explicitly solicits information about the critical aspects of a project in terms of the Who, What, Why, When, Where, and How of the project. By using this approach, we can avoid taking cooperation for granted. Cooperation must be explicitly pursued through clear communication of the project requirements. Cooperation works only when each cooperating individual inwardly believes in the project and makes a personal commitment to support the project. Ceremonial signing-off on a project is not a guarantee of cooperation. Rather, subconscious signing-into the project is what makes a sustainable cooperation. This can only be achieved through communication, extended appropriately and received properly.

## Conclusions and Recommendations

The purpose of this article is not to indict DoD's 2013 furlough program, which is necessitated by the national-level budget sequestration problem. Rather, the article seeks to sensitize decision makers to the diversity of critical issues and factors involved in any DoD furlough program, particularly if it affects the acquisition community. For example, the Weapon Systems Acquisition Reform Act and the Defense Acquisition Workforce Improvement Act represent two of the several


initiatives designed to improve the acquisition process. But to realize real and lasting improvements, which have been elusive so far, new practical approaches must be explored and sustained. But when the adverse impact of a furlough program is added on top of the existing challenges, it becomes even more difficult to achieve acquisition excellence or sustain any improvement already achieved. The recommendations derived from this article are summarized below:

- While changes are essential for organizational improvement, they should be implemented in smaller manageable chunks with respect to implementing furloughs in incremental cost-cutting measures rather than one big furlough period.

- Focus should be on gradual incremental improvement rather than one-fell-swoop drastic implementation of budget cuts.

- Early and clear communication should be used to clarify the requirements and impacts to allay the fear of those affected.

- The personal needs and welfare of employees should be given priority in the execution of furlough programs.

- The questions of who, what, why, when, and how of the furlough program should be clearly delineated upfront to minimize ambiguity.

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A final take-away from this article is succinct, but nevertheless profound: 100 percent of the work during a furlough cannot be done with fewer resources at the original work rate.

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**Keywords:** *Patent Rights, Government IP Rights, Technology Transfer, Software Data Rights*

# *Data Rights for Science and Technology Projects*

*Larry Muzzelo and Craig M. Arndt*

Defense Acquisition Workforce and defense industry professionals engaged in the acquisition decision process must have extensive knowledge of the relationship between government ownership of Technical Data Rights and the transition of technology from the Science and Technology (S&T) community into Programs of Record (PoR). For purposes of this article, the author's objective was to identify ways to increase such understanding and promote successful transition of Technical Data Rights through use of survey questionnaires that solicited feedback. This research concluded that Program Executive Officers and Program Managers were transitioning the associated Technical Data Rights along with the Advanced Technology Development products; and that DoD ownership of Technical Data Rights makes a statistical difference in the successful transition of technologies.

*« Image designed by Diane Fleischer*

The Department of Defense (DoD) tasks its Science and Technology (S&T) community to develop innovative technologies that will drive the technological advancements in its weapon systems. Historically, the DoD has been challenged to transition these pioneering technologies into Programs of Record (PoR)—acquisition programs that are recorded in the current Future Year's Defense Program (FYDP) or updated from the last FYDP by approved documentation, such as Acquisition Program Baseline, acquisition strategy, or Selected Acquisition Report. Program Executive Officers (PEO) and Program Managers (PM) have the responsibility to engineer, integrate, and deploy DoD's advanced weapon systems. Concurrent with this technology transition challenge, the DoD is placing renewed emphasis on government ownership of technical data for use throughout the acquisition life cycle.



## Background

Title 10, United States Code Section 2320, Rights in Technical Data (2012), has been in force for many years and is instantiated in both the Federal Acquisition Regulation(FAR), (General Services Administration [GSA], DoD, & National Aeronautics & Space Administration, 2005) and Defense Federal Acquisition Regulation Supplement(DFARS) (DoD, 1998). These rights depict who owns the technical data and are typically of three types. The unlimited technical data rights provision allows the government the right to use, disclose, reproduce, or prepare derivative works or distribute copies in any manner and for any purpose, and to have or permit others to do so. The limited technical data rights provision is for data delivered with disclaimers specifying how the government may use or disclose the data. Conversely, the data may be withheld from delivery or specified via form, fit, and function information only (Bozeman, 2000). These rights can take many forms, such as build to print; source code; object code; form, fit, and function; and maintenance, installation, and training (Rights in Technical Data, 2012).

In some instances, the government may have no technical data rights and instead must pay license fees to use the product. A classic example is licensing of computer software developed at private expense.

The Weapon Systems Acquisition Reform Act of 2009 and the Better Buying Power Initiative 2.0 (Kendall, 2012) have identified the need to increase the use of open architectures, use technology development for true risk reduction, and implement a technical data rights strategy over a product's life cycle, including acquiring the technical data rights while competition still exists.

***The DoD depends on its research laboratories to develop and transition new technologies and systems that enhance or improve military operations and ensure technological superiority over adversaries.***

Erwin (2012) indicates that industry is increasingly concerned over potential government demands for drawings, specifications, and manufacturing methods so future procurements can be made, in some cases, using other sources. She further notes that DoD is requiring industry to turn over data rights, but that some of the technical data being provided to the DoD are developed with industry's own funds, and that the DoD's desire for the best and latest technology is potentially irreconcilable with its policies calling for competition in the marketplace.

## Problem Statement

Although a strategy in technical data rights exists at the Department, Service, and PEO levels, no integrated and overarching strategy and guidance is commonly enforced and executed throughout the DoD. Without a consistent approach to purchasing technical data rights for technology development projects, and a potential lack of understanding as to the resultant implications, the determination on whether to purchase technical data rights for these projects is subject to wide variations. The purpose of this article is to analyze the impact of government ownership of technical data rights on the transition of technology from the S&T community to PEOs and PMs. S&T Advanced Technology

Development (ATD) projects have an end goal of transitioning products into acquisition programs that will provide military utility and satisfy user requirements.

This research analyzed completed questionnaires provided to the Army Materiel Systems Analysis Activity (AMSAA), which is investigating internal technology transitions within the S&T community as well as external transitions to PEOs/PMs. By analyzing the completed questionnaires, an assessment of ATD project transition success, or lack thereof, conducted on behalf of PEOs/PMs over the past 10 years will indicate if government ownership of technical data impacts transition success.

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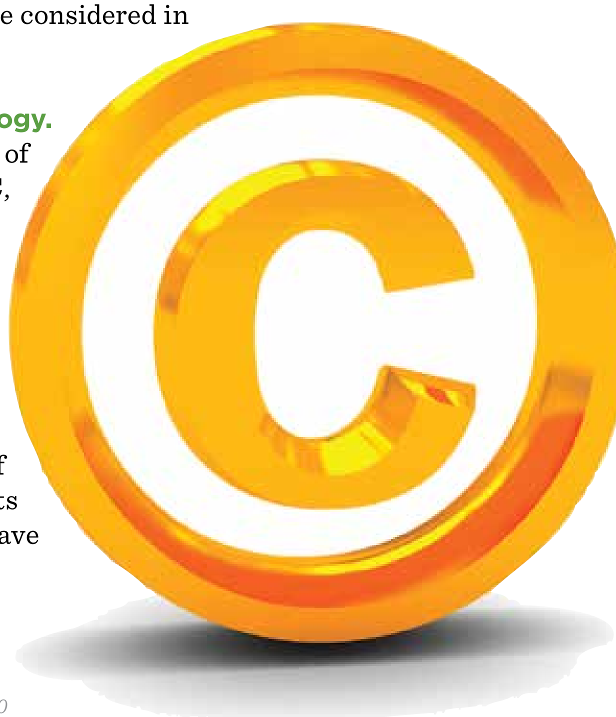
## Research Hypothesis

Government ownership of the technical data rights makes no difference in transition of technology projects from the S&T community to PoRs. In other words, data rights have no effect on a project's ability to transition to an acquisition program.

## Literature Review of Technology Transition

A significant body of literature has been written about technology transfer and transition (Nambisan & Sawhney, 2007). To better understand the different issues that have been identified within the literature, this section is organized into discussions of the three major theisms in the literature: (a) why we transition technology, (b) barriers to technology transfer, and (c) factors to be considered in evaluating technology transfer.

**Why we transition technology.** The National Research Council of the National Academies (NRC, 2004) pointed to industry and research experience in fields such as history of technology, business, and social sciences as ways in which the "social, cultural, and historical factors influence adoption, implementation, and long-term acceptance of new technology" (p. 9). It asserts that scientists and engineers have



a tendency to see only the technology solutions as causing a failure of technology transition while overlooking these other factors as well as the problem of communication. The interactions between organizational subcultures are vital in determining the success or failure of technology transition. Technology transition is critically dependent on individuals who can successfully manage this interaction, while "fostering the communication that is the essence of successful technology transition" (p. 11).

Brown (2002) argues that in times of rapid and unpredictable change, corporate researchers need to help companies invent new practices and processes to increase their flexibility rather than solely focusing on the next technology or on product development as the centerpiece of innovation. He offers four suggestions to improve an organization's innovation aptitude: (a) investing in research on new work practices, (b) learning how to use the innovation that exists throughout the entire company, (c) coproducing innovation by partnering with others throughout the organization to transmit the innovation, and (d) understanding that the ultimate innovation partner is the customer.



**Barriers to technology transfer.** Arcella (2005) argues that, to understand how to overcome the low success rate of technology transition through the so-called "valley of death" in the DoD, one needs to look to technical entrepreneurs and salespeople from small start-up companies. The safe path is to stay with legacy systems, thereby eliminating buyer's risk and precluding any red flags and finger-pointing.

The DoD depends on its research laboratories to develop and transition new technologies and systems that enhance or improve military operations and ensure technological superiority over adversaries. Dobbins (2004) explained that technology transition is the process by which technology deemed to be of military use is transitioned from an S&T environment for incorporation into an existing or new-start acquisition program. He also noted that since available technologies suitable for transition usually are not part of the acquisition program's Program Objective Memorandum, this can result in the candidate projects being at risk for successful transition.

The DoD's ability to successfully and routinely take advantage of its significant investment in S&T programs—funded at $12.2 billion in FY12—and transition the technologies coming out of its laboratories, has been the focus of several Government Accountability Office (GAO) studies and analyses to better understand the challenges and identify possible solutions. The GAO (2005) noted that DoD historically has experienced problems bringing technologies out of the laboratory environment.

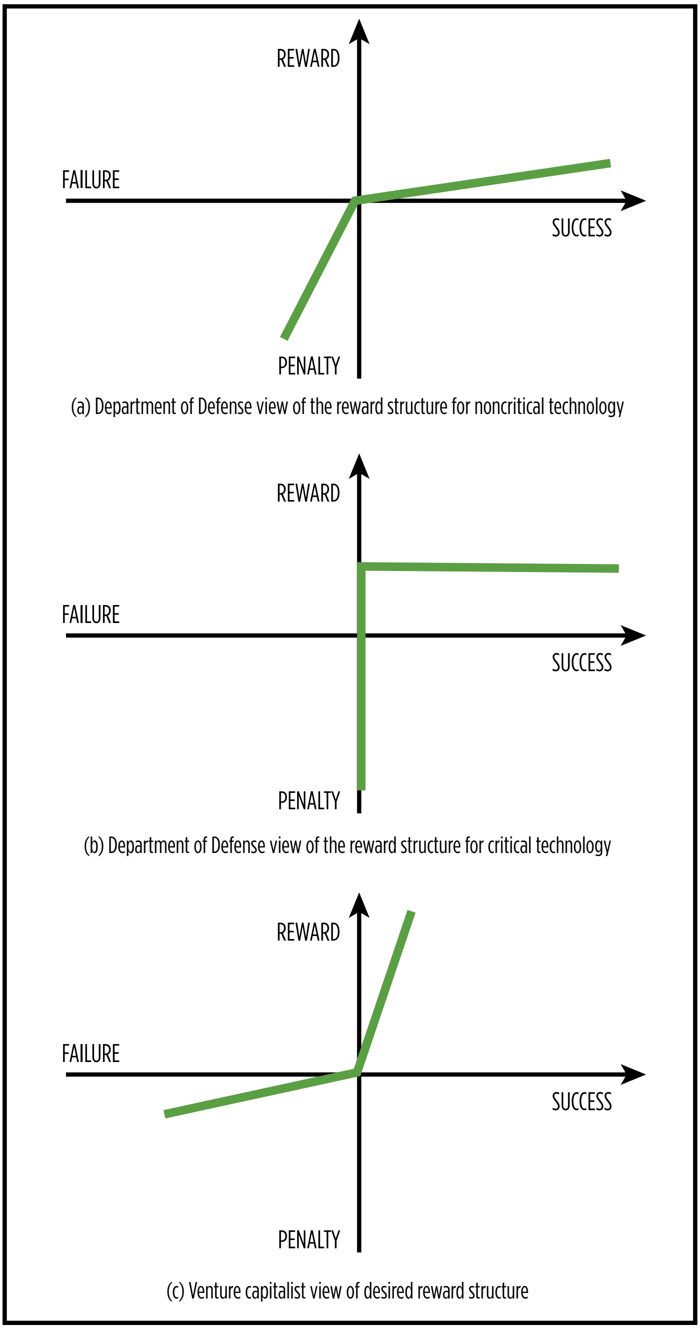
Flitter (2008) provides a programmatic definition of technology transition as being the "successful transfer of responsibility for development, testing, and integration of a technology from the S&T community to the acquisition community" (p. 5). He further enumerates that transition involves the "incorporation of a technology into the design for, or production of, an acquisition product" (p. 5). Pezzano and Burke (2004) clearly articulate the need to transition programs from the S&T community into the acquisition system to enable a transforming Army. However, they assert this must be accomplished with maximum flexibility and an approach that reduces risk. However, creativity is required to meet the unique needs of a program and make the most efficient use of our scarce research and development resources (p. 22).



***Unlike the DoD, the venture capitalist view places a high value on success and a relatively low penalty for failure, which creates a strong incentive to succeed while accepting failure as part of the process.***

The NRC (2004) identified the risk-reward relationship as a primary barrier for successful transition and insertion of new technologies. "This attitude within the DoD that so heavily penalizes failure and does not provide appropriate rewards for success breeds a culture that is, by nature, averse to transitioning new technology very rapidly, or at all" (p. 24). Figure 1 provides a comparison between the DoD and venture capitalist perspective of the value of success and penalty of failure for a particular technology. Unlike the DoD, the venture capitalist view places a high value on success and a relatively low penalty for failure, which creates a strong incentive to succeed while accepting failure as part of the process.

**FIGURE 1. DIFFERENT VIEWS OF THE REWARD STRUCTURE FOR NEW TECHNOLOGIES**

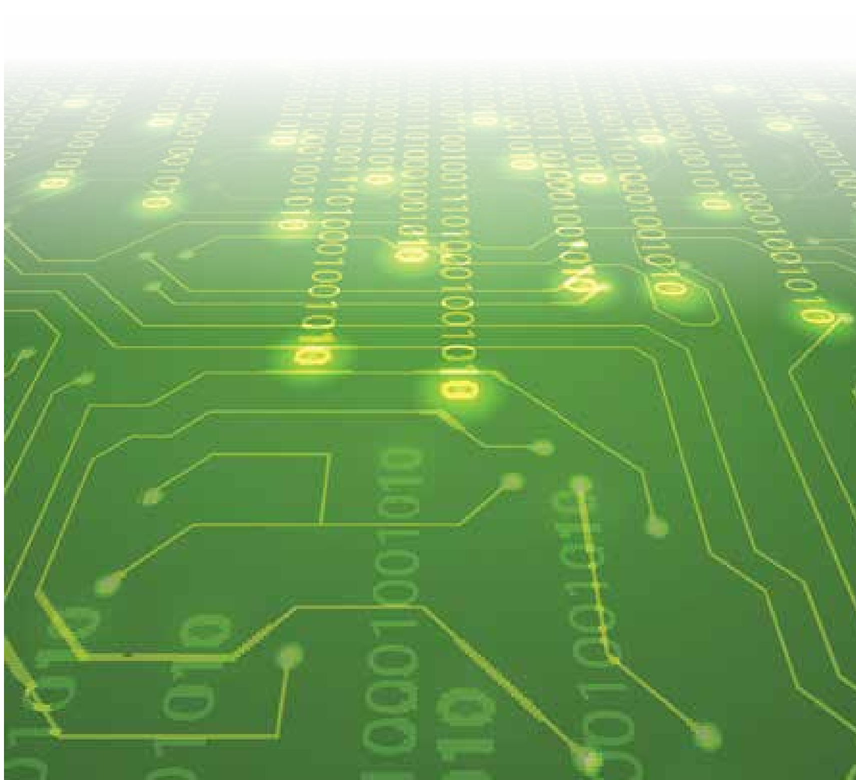


The NRC (2004) asserted that for military systems, the fear of failure and accompanying penalties represent a key barrier to moving forward in transitioning new technologies. The NRC (2004) did not identify a single strategy that, if implemented, will accelerate insertion of new technologies into military systems. But, "it is more likely that the omission of a key element of the many needed will guarantee failure" (p. 2).

Flitter (2008) offered the notion that the best transition occurs when there is no perceived transition, but a seamless and continuous process from concept, development, test, production, and fielding of the technology.

### Factors to be considered in evaluating technology transfer.

Albors-Garrigos, Hervas-Oliver, & Hidalgo (2009) analyzed mechanisms that influence the transfer and marketing of advanced technology and proposed a construct to explain how advanced technology is



transferred, diffused, and adopted by users in a firm. They used a value mapping methodology adapted to the case of advanced technology and determined that variables such as technology complexity, market barriers, and relationships between researchers, developers, and final users are critical to technology transfer.

Similarly, Choi (2009) found that for effective technology transfer, the technology provider needs to help change the adopters' perception of technology and consider the adopters' willingness to accept technology. Among the key factors to this acceptance are relationships and informal communication. In this process, the technology providers must play a key facilitating role and "should try to transfer to its adopters all resources and capabilities needed to use, modify, and generate the technology" (p. 55).

Iansiti and West (1997) surmise that a company's ability to choose technologies wisely has a large impact on the performance of its research and development organization in terms of time to market, productivity, and product quality. They identify technology integration as a methodology companies use to identify, refine, and then select technologies for employment in a new product, process, or service. They say the more effective organizations follow a process characterized by three factors, which include: (a) emphasizing technology integration activities, (b) following specific approaches to investigate the impact of novel technologies on product functionality and system performance, and (c) dedicating to the process personnel who had prior experience with technology integration and are knowledgeable about the organization's capabilities.



## Literature Review of Technical Data Rights

A number of known issues surround the procurement and use of data rights. In reviewing the literature, included are both specific issues with data rights procurement identified in the literature and also a number of recommendations for improving the DoD management of data rights during weapon systems development. This section presents a summary of these two major areas of the literature.

The statutory and regulatory requirements for the government's technical data rights depend on included contract clauses as prescribed by the FAR (GSA et al., 2005). The clauses are from Subpart 52.2 and include 52.227-14 through 23 as prescribed by Subpart 27.4. In contracting for ATD projects, data rights clauses might include one or more of the following:

- FAR 52.227-14: Rights in Data—General
- FAR 52.227-15: *Representation of Limited Rights Data and Restricted Computer Software*
- FAR 52.227-16: *Additional Data Requirements*
- FAR 52.227-17: *Rights in Data—Special Works*
- FAR 52.227-18: *Rights in Data—Existing Works*
- FAR 52.227-19: *Commercial Computer Software License*
- FAR 52.227-23: *Rights to Proposal Data (Technical)*



Clauses 52.227-14, -15, and -16 will be the ones most typically utilized and deserve more detailed discussion. Under FAR 52.227-14, *Rights in Data–General*, the contractor protects proprietary data by withholding it or delivering it with restrictive markings specified by the FAR (GSA et al., 2005). The government receives unlimited rights for all data first produced in performance of the contract; form, fit and function data; and data delivered under the contract. Unlimited Rights include the right to use, disclose, reproduce, prepare derivative works, distribute copies to the public, and perform publicly, in any manner and for any purpose, and to have or permit others to do so. Exceptions are for limited rights data and restricted computer software. The contractor may withhold proprietary data and only has to deliver form, fit, and function information about the withheld data unless either the Limited Rights (Alternate II) or Restricted Computer Software (Alternate III) portions of the FAR clause are incorporated into the contract. Limited rights data embody trade secrets that the contractor protects by withholding from delivery unless the Limited Rights (Alternate II) provision of the clause is incorporated into the contract. In this case, the contractor must deliver the limited rights data, marked in specific terms, with how the government may use and share the data. These limited rights may be negotiated between the government and contractor. Restricted computer software is developed at private expense, which the contract protects by withholding unless the Restricted Rights (Alternate III) provision of the clause is incorporated into the contract. In this case, the contractor has to deliver the restricted computer software with markings that specify the limits of the government's use of the restricted computer software. The restricted rights may be negotiated between the government and contractor. Under FAR 52.227-14 and as prescribed by FAR Subpart 27.4, 27.406-1(c), the government does not normally require a contractor to provide unlimited data rights that otherwise would be limited rights or restricted computer software. FAR 52.227-15, Representation of Limited Rights Data and Restricted Computer Software, requires the contractor to identify data it intends to withhold or deliver with limited rights or restricted computer software. FAR 52.227-16, Additional Data Requirements, requires delivery of data not specified for delivery in the contract.



***... the GAO (2006b) asserted DoD should strengthen policies for assessing technical data needs to support weapon systems since a crucial consideration in managing the life cycle of a weapon system is the availability of the item's technical data...***

## Known Data Rights Issues

The GAO (2006a; 2006b) reported on DoD's failure to obtain sufficient technical data rights for seven major weapon systems. In the report, the GAO made two major findings: (a) that the Army and Air Force's failure to obtain technical data rights in procuring certain weapon systems was found to have proven problematic as the Services try to sustain these weapon systems; and (b) that DoD's acquisition policies do not require obtaining technical data rights when procuring major weapon systems. Furthermore, the report cited the use of performance-based acquisition strategies by the DoD as obviating, as perceived by some in the DoD, the need for data or data rights.

## Recommendations for Improving Data Rights Management in the DoD

In its report, the GAO (2006b) asserted DoD should strengthen policies for assessing technical data needs to support weapon systems since a crucial consideration in managing the life cycle of a weapon system is the availability of the item's technical data, which is necessary to design and produce, support, operate, or maintain an item. Among the GAO's (2006b) recommendations were to "specifically require program managers to assess long-term technical data needs and establish corresponding acquisition strategies that provide for technical data rights needed to sustain weapon systems over their life cycle" (p. 19). It also recommended that the Secretary of Defense require that the GAO's recommendations be included in mandatory acquisition guidance, such as DoD Directive 5000.1 (DoD, 2003) and Interim DoD Instruction 5000.2 (DoD, 2013). The Interim DoD Instruction 5000.2 has incorporated these recommendations.

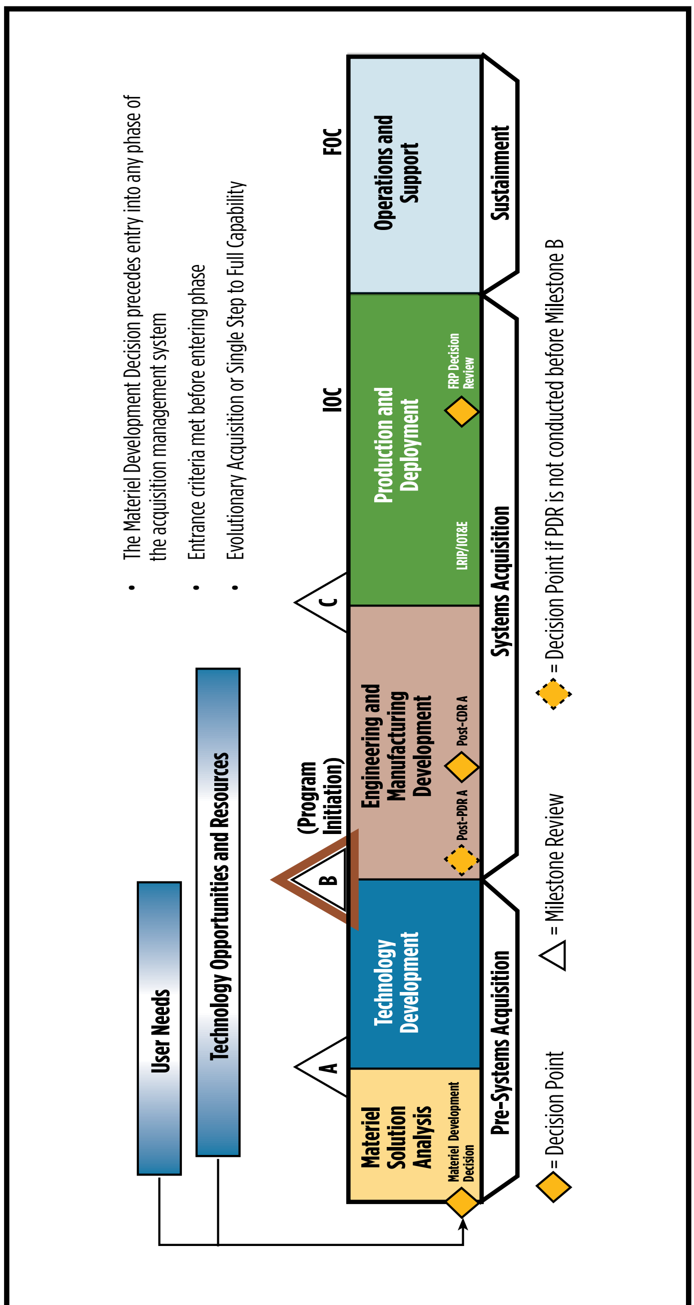


In discussing key elements of the Kendall (2010) memorandum, *Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending*, Medlin and Frankston (2012) identify open systems architecture and the related acquisition of technical data rights as being integral to the engineering trade-off analysis that will be completed and presented at a program's Milestone B. The Milestone B is a Milestone Decision Review at the end of the Technology Development phase of a DoD program's acquisition life cycle, the purpose of which is to determine whether or not a program is ready to enter the Engineering, Manufacturing, and Development phase (Figure 2).

Medlin and Frankston (2012) describe the major purpose of an open architecture and the acquisition of technical data rights as necessary to "ensure the government has the right information to compete future contracts (i.e., design documentation, interfaces, tools, and information that can be shared with others)" (p. 32).

Conversely, Mazour (2009) argues that government contractors should be allowed to keep as many exclusive rights in technical data as possible and only provide the government with the minimum needed for government procurements.

FIGURE 2. ACQUISITION PROGRAM LIFE CYCLE




*Note.* CDR = Critical Design Review; FOC = Full Operating Capability; FRP = Full-Rate Production; IOC = Initial Operating Capability; IOT&E = Initial Operational Test & Evaluation; PDR = Preliminary Design Review; LRIP = Low Rate Initial Production.

Watts-Horton (2009) investigated factors in purchasing technical data, specifically in the context for the long-term sustainment of military systems. Among her findings were

- technical data rights have been confusing, ambiguous, and contradictory, and at times leading to misinterpretation;
- the DFARS (1998) is a complex set of regulations mostly understood by legal personnel, but lacking clarity of understanding in nonlegal terms;
- a lack of readily available data rights training pervades outside of the procurement functional domain; and
- financial pressures may be exerted to buy either more items or more capability in lieu of technical data rights.



## Research Process

The research process utilized a survey to gather the requisite data. The AMSAA study, concluded in February 2013, examined the past 10 years of Army ATD projects to identify factors contributing to the transition, or anticipated transition, of a technology product to a PoR. The AMSAA study was inquiring about a number of key issues related to specific Army ATD programs, including specifically where technology was developed, if and how it was transitioned, and the effects of data rights ownership on how the Army managed its programs. Other factors examined in the AMSAA study included the types of technology transitioned, the size of the programs, the maturity of the programs, and the maturity of the technologies. Several different factors were discovered to have little effect on the likelihood of successful transition. AMSAA queried each PEO/PM identified by the U.S. Army Research, Development and Engineering Command as an ATD technology project customer. The identified customer PEOs included PEO Ammunition; PEO Aviation; PEO Combat Support & Combat Service Support; PEO Command, Control and Communications–Tactical; PEO Ground Combat Systems; PEO Intelligence, Electronic Warfare, and Sensors; PEO Missiles and Space; PEO Soldier; and PEO Simulation, Training and Instrumentation. The survey also requested information as to whether or not the project transitioned a product to a PEO/PM for use in a PoR.

## Data Collection

Eighty-three questionnaires were distributed to the identified customer PEOs/PMs on October 23, 2012, requesting responses by November 16, 2012. Responses were received between November 16, 2012 and January 11, 2012. Of the 83 questionnaires distributed, 78 responses were received from the surveyed PEOs/PMs covering 71 different projects—a response rate of 86 percent. The PEOs/PMs could not provide input for 12 of the projects due to personnel losses and/or a lack of knowledge on the project.

## Findings

The objective of this research was to improve the understanding between Defense Acquisition Workforce and defense industry professionals engaged in the acquisition decision process, of the relationship between ownership of technical data rights and the transition of technology from the S&T community into PoRs.

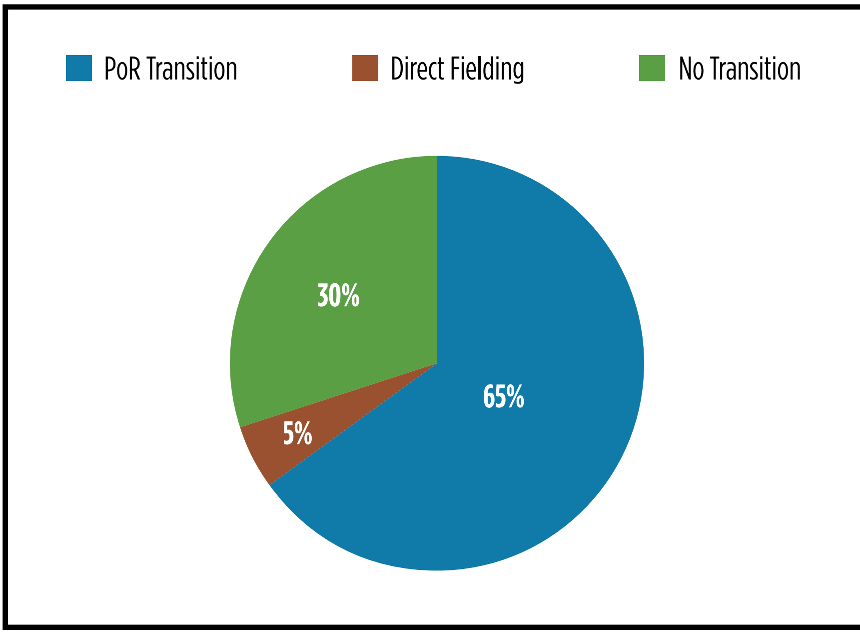


## Population & Sample Size

Eighty-three projects were included in the analysis when surveying PEOs/PMs via questionnaires. Of the 83 projects, the PEOs/PM provided survey responses on 71 separate projects. Of the 71 projects for which survey data were received, 40 were identified as transitioning a technology product to a customer's PoR. An additional four projects were identified as transitioning technology directly to the warfighter, either through a Quick Reaction Capability or Joint Urgent Operational Need executed by the PM, rather than through continued technology maturation and development as would be typical in the standard acquisition life cycle. These 71 projects form the underlying data set for the research analysis and findings.

After excluding the data determined to be meaningless, 57 projects remained to be included in the analysis. Figure 3 portrays the transition status for the projects included in the analysis and includes 37 projects transitioned to a PoR, three projects directly fielded, and 17 projects not transitioned.

**FIGURE 3. S&T PROJECT TRANSITION STATUS**




A top-level summary of the data rights associated with each project included in the analysis is provided in Table 1.

**TABLE 1. SUMMARY OF TECHNICAL DATA RIGHTS OF SURVEYED PROJECTS**

| Transition Scope | Unlimited Rights | Limited Rights | No Rights |
|---|---|---|---|
| Program of Record Transition | 12 | 23 | 2 |
| Transition via Direct Fielding | 3 | 0 | 0 |
| No Transition | 3 | 9 | 5 |

The S&T products provided to the PEO/PM recipients took various forms. The possible nature of the various products is categorized in Table 2. The form or nature of the S&T product that was provided to the recipient is identified in Table 3, which includes products transitioned to a PoR, products directly fielded, and those not transitioned.

Table 4 identifies the form of those products that had unlimited rights. Table 5 shows the form of those products that limited data rights. Table 6 identifies the form of the products with no data rights.

**TABLE 2. FORMS OF S&T PRODUCTS**

| Form | Description |
|---|---|
| System | A complete, multi-component system that will be used or produced by the recipient |
| Hardware End Item | A materiel product that will be used or produced by the recipient |
| Component | A (sub-)component of the Hardware End Item |
| Software/Algorithm | |
| Knowledge Product | The knowledge product can take many sub-forms including: inform requirements (i.e. technology trade-offs); inform acquisition (inform AoA, specification for RFP); standards, certification or accreditation; data analysis or report (including M&S or assessment reports); Scientist & Engineering support for follow-on development; Training, Leadership or Education |
| People | Matrixed personnel or subject matter experts to a non-S&T organization for technical expertise/knowledge |

**TABLE 3. S&T PRODUCT FORM**

| Transition Scope | System | Hardware End Item | Component | Software, Algorithm | Knowledge Product |
|---|---|---|---|---|---|
| Program of Record | 6 | 7 | 10 | 12 | 2 |
| Direct Fielding | 1 | 0 | 2 | 0 | 0 |
| No Transition | 3 | 1 | 9 | 1 | 3 |

4

**TABLE 4. S&T PRODUCT FORM FOR PROJECTS WITH UNLIMITED DATA RIGHTS**

| Transition Scope | System | Hardware End Item | Component | Software, Algorithm | Knowledge Product |
|---|---|---|---|---|---|
| Program of Record | 3 | 0 | 2 | 6 | 1 |
| Direct Fielding | 1 | 0 | 2 | 0 | 0 |
| No Transition | 0 | 0 | 3 | 0 | 0 |

**TABLE 5. S&T PRODUCT FORM FOR PROJECTS WITH LIMITED DATA RIGHTS**

| Transition Scope | System | Hardware End Item | Component | Software, Algorithm | Knowledge Product |
|---|---|---|---|---|---|
| Program of Record | 2 | 7 | 8 | 6 | 0 |
| Direct Fielding | 0 | 0 | 0 | 0 | 0 |
| No Transition | 1 | 0 | 5 | 0 | 3 |

**TABLE 6. S&T PRODUCT FORM FOR PROJECTS WITH NO DATA RIGHTS**

| Transition Scope | System | Hardware End Item | Component | Software, Algorithm | Knowledge Product |
|---|---|---|---|---|---|
| Program of Record | 1 | 0 | 0 | 0 | 1 |
| Direct Fielding | 0 | 0 | 0 | 0 | 0 |
| No Transition | 2 | 1 | 1 | 1 | 0 |

## Analysis

The collected data were analyzed by performing an analysis of variance (ANOVA) test calculated from the null hypothesis and the three sample groups consisting of unlimited rights, limited rights, and no rights. In each of the three groups, if a project transitioned it was assigned a value of 1, while a project that failed to transition was assigned a value of 0.

The ANOVA statistical test yielded an F statistic of 3.980 with a probability of the result, assuming the null hypothesis, of 0.024. The probability of the result is less than 0.05. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted, implying that government ownership of technical data rights makes a difference in technology transition (Krejcie & Morgan, 1970).

All PEOs and PMs and all "receiving" programs are not the same. As a practical matter, the receiving programs differ in at least two important parameters—size (and by inference, who gets to make decisions) and phase.

The majority of the programs in our study are Acquisition Category (ACAT II) programs, and the programs are, for the most part, in a pre-MS C phase. This is consistent with the fact that the majority of Army programs are not ACAT I programs, and that most technical data are generated early in the life cycle of most programs.

## Conclusions

From the questionnaire responses of the ATD projects surveyed as part of this research, it becomes increasingly apparent that government ownership of technical data rights makes an important difference in the successful transition of technologies from the S&T community to PoRs. Success of transition is defined as "the specific new technologies being incorporated into the PoR." The government's understanding and that of the acquisition community at large, is that owning technical data rights increases the likelihood that technology will transition. Owning the data rights also enables the government to have greater flexibility for incorporating technology products in acquisition programs. Without ownership of technical data rights, the ability to transition technology is decreased, and the government will be constrained in its use of the technology products by the company owning the data rights.

## Recommendations

From survey findings, this research reveals that government ownership of rights makes a difference in the transition of technology. To make effective use of this finding, three recommendations are offered:

- Increase collaboration between the S&T project office and the program management office that is the intended recipient of the technology. This will enable a better understanding of the PM's planned use of the technology, how the technology fits within the PM's road map, as well as how the data ownership thereof corresponds to the acquisition program's overall Technical Data Rights Strategy.

- Increase training and ensure S&T project office personnel (and program office and PEO staff) understand that buying technical data rights is a business decision that can ultimately impact technology transition.

- Prepare an overarching written Technology Agreement document to increase communication between the S&T project offices and PMs on the technical data rights approach. The discussion process that results in an agreed-upon Transition Agreement will help ensure that the S&T organization maintains a customer focus and that an open dialogue exists between the S&T community, as technology provider, and the PM, as technology adopter.

Although the results of this study seem to indicate the importance of data rights ownership to the successful transition of technology, additional research is needed to draw definitive conclusions about the larger set of Army and DoD programs.

## Areas for Future Research

In order to learn more about the impact of data rights on the transition of technology, the authors recommend that future research expand the scope of programs studied, including an analysis of different measures of return on investment, and examine the effect of the class of system being developed. Specifically, we recommend the following six study areas as the next steps in the field of research:

### Six Additional Areas are Suggested for Further Research

First, expand the projects researched beyond just ATDs since the S&T community also invests in, and develops technologies through, smaller programs.

Second, evaluate the effects of policy changes in the area of data rights on program success.

Third, evaluate the specific return on investment of investing in data rights.

***... the research should be expanded to include our NATO and other allies who also negotiate data rights, both in their acquisition and in dealing with U.S. vendors when buying U.S.-developed systems.***

Fourth, research whether program acquisition strategies clearly provide an appropriate data rights strategy for the S&T community to follow.

Fifth, research how the documented agreements between the S&T community as technology providers, and the PM community, as technology adopters, communicate the needed rights to enable technology transition and technology use in major defense acquisition programs.

The sixth and last area offered for additional research is to assess the effect the S&T product form (i.e., system, hardware, software, component, knowledge product, etc.) has on data rights appropriate for subsequent S&T project transition success. In addition, the research should be expanded to include our NATO and other allies who also negotiate data rights, both in their acquisition and in dealing with U.S. vendors when buying U.S.-developed systems.

## Author Biographies

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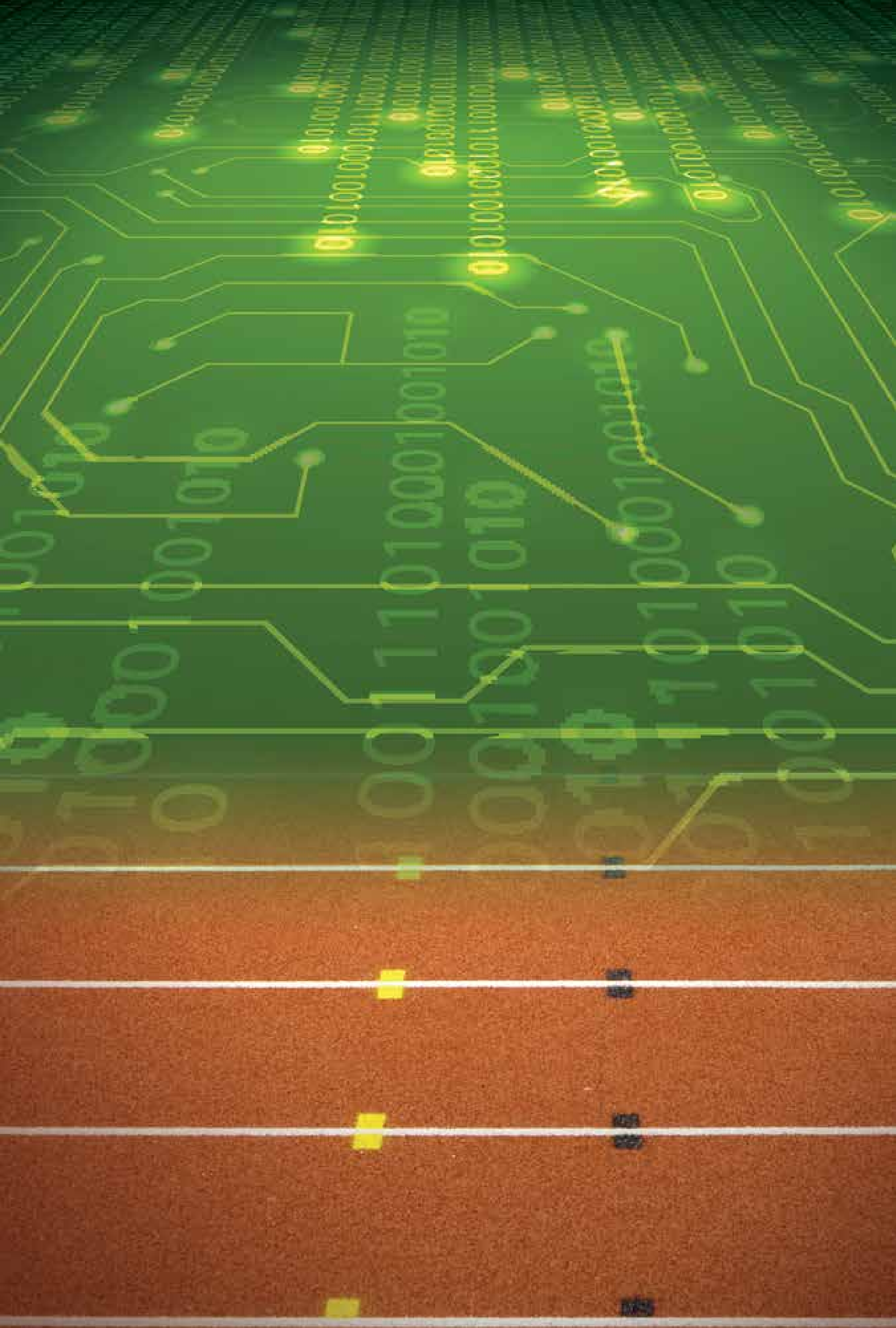

# Professional Reading List

The Defense Acquisition Professional Reading List is intended to enrich the knowledge and understanding of the civilian, military, contractor, and industrial workforce who participate in the entire defense acquisition enterprise. These book reviews/recommendations are designed to complement the education and training that are vital to developing the essential competencies and skills required of the Defense Acquisition Workforce. Each issue of the *Defense Acquisition Research Journal (ARJ)* will contain one or more reviews of suggested books, with more available on the *Defense ARJ* Web site.

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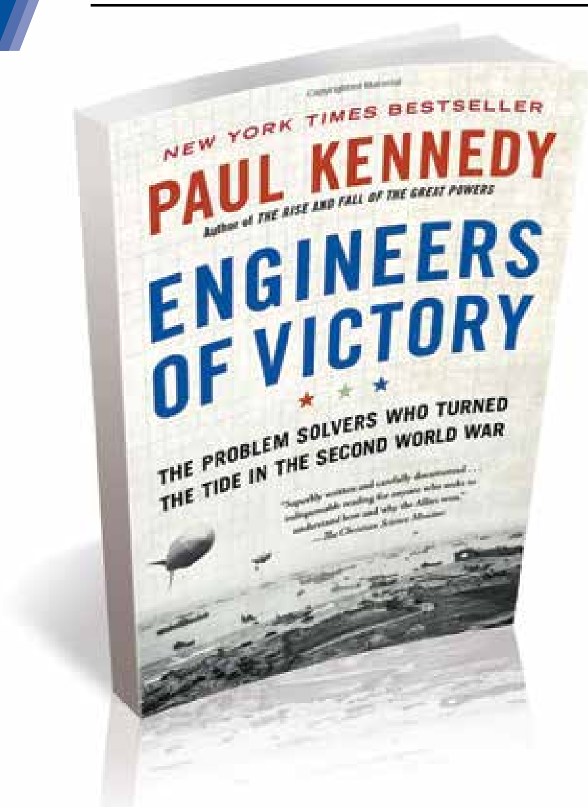



## Featured Book

*Engineers of Victory: The Problem Solvers Who Turned the Tide in the Second World War*

**Author(s):**
Paul Kennedy

**Publisher:**
Random House Trade Paperbacks

**Copyright Date:**
2013

**Available Online:**
http://www.amazon.com/Engineers-Victory-Problem-Solvers-Turned/dp/0812979397

**Hard/Softcover:**
480 pages

**Reviewed by:**
Dr. Glen R. Asner, senior historian, Historical Office, Office of the Secretary of Defense

**Review:**

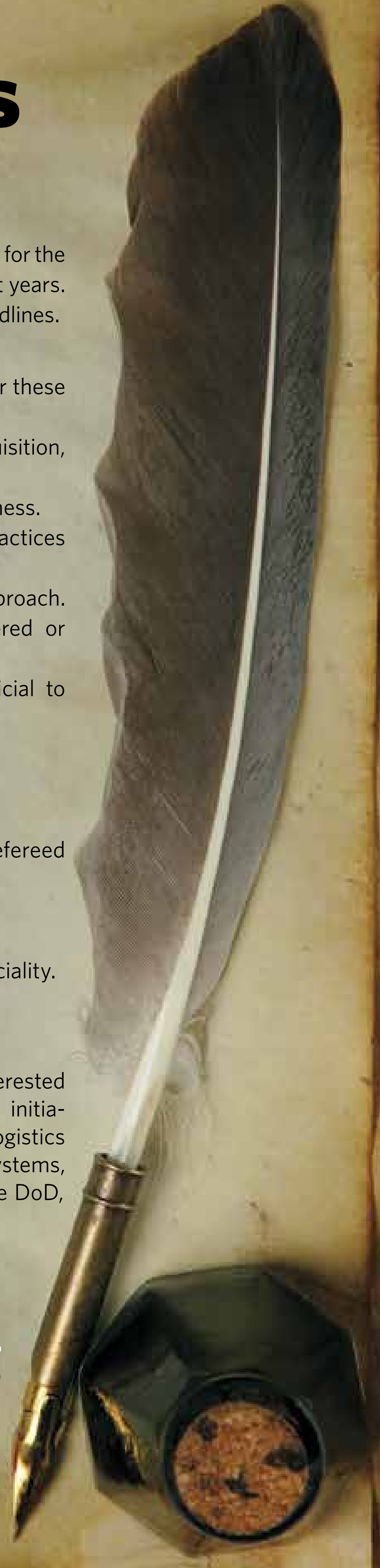
Paul Kennedy's Engineers of Victory offers a nuanced, multicausal explanation for the outcome of World War II. Across five lengthy chapters, the author identifies what he considers the key decisions, battles, technological advances, and operational achievements that account for ultimate victory against Germany and Japan. Each chapter focuses on a different major operational challenge the Allies had to overcome to turn the tide of World War II in their favor: halting the U-boat menace to ensure safe passage for supplies and troops across the Atlantic; knocking out the Luftwaffe to gain control over the skies of Germany; countering the Wehrmacht's Blitzkrieg ("lightening war") strategy to reverse German advances on the Eastern Front; seizing an enemy-held shore in the Normandy invasion to open up the Western Front; and fighting across a great expanse—the Central Pacific—to reach Japan and destroy its war-making capabilities.

While Kennedy acknowledges that the Allies' tremendous advantages in output of war material beginning in 1943 partly explain the outcome of the war, he contends that Allied victory also rested on differences in how each side approached geographic challenges and differences in the culture and organization of their "war-making systems." The Axis powers badly overreached, most egregiously on the Eastern Front and in the Pacific, while the Allies were more sensitive to the role of geography and, most importantly, were better at learning from mistakes, transmitting and circulating knowledge, and encouraging innovation in all endeavors.

Readers unfamiliar with the war will appreciate the tightly packed overviews of key battles and campaigns, as well as helpful summaries of major operational challenges, such as amphibious landings or strategic bombing sorties, juxtaposed across the larger history of warfare. Knowledgeable readers will be frustrated by factual errors that plague the text and how much is left out of the story, particularly in the discussion of the Pacific campaign. Those looking for insights on engineering and acquisition during World War II will be disappointed. The author pays tribute to the role of technology and production, and to those who called forth, designed, built, and improved upon critical weapon systems, but only in a cursory fashion and without providing much insight on how technological advances occurred.

Yet, this book is a worthwhile read, primarily for the author's ambitious effort to show how all aspects of the war—from high diplomacy and the factory floor, to the training and equipping of troops and the battlefield—were intimately linked and interdependent. For politicians, war planners, soldiers, weapons developers, and acquisition professionals, Kennedy's main argument is worth remembering: the Allies won "because they possessed smarter feedback loops between top, middle, and bottom; because they stimulated initiative, innovation, and ingenuity; and because they encouraged problem solvers to tackle large, apparently intractable problems." Founded on strong educational and economic systems and a culture of innovation, these attributes are no less important today for military and political advantage than they were 70 years ago.

# Call for Authors



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*Research* involves the creation of new knowledge. This generally requires using material from primary sources, including program documents, policy papers, memoranda, surveys, interviews, etc. Articles are characterized by a systematic inquiry into a subject to discover/revise facts or theories with the possibility of influencing the development of acquisition policy and/or process.

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